

The Blast Furnace and Steel Plant

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The Blast Furnace *and* Steel Plant

Vol. XIII

PITTSBURGH, PA., JANUARY, 1925

No. 1

SAFETY

As we enter the New Year filled with the optimism which seems to electrify the industrial atmosphere, we cannot fail to observe the thought tendencies of true leaders.

Secretary Hoover comes out squarely for better and more concrete understanding of the menacing Safety problem. No one better than Mr. Hoover realizes that full employment and record production have carried inevitably with them higher accident and mortality rates; the resultant curves seem to parallel.

President Coolidge sounds the clarion in no uncertain tones—the life and limb of human beings transcends all other interests.

Shall the steel industry content itself with a perfunctory campaign based on past performances, or shall it take up the gauntlet and fulfil the prediction made by Charles Close that steel can be made in plants where accident records are 100 per cent clean?

This is an issue before 1925.

Iron and Steel Review of 1924

Remarkable Changes Are Noticeable in Influences Which Shape
Production Schedules, Selling Prices, and Employment

By B. E. V. LUTY*

THE course of trade in iron and steel rings so many changes that it is difficult to pick out the salient features of a given year. Each year has so many peculiarities that the count of peculiarities becomes monotonous.

We are not through with war influences, although the war is six years past, and never shall be completely. We want to know how things are different, by reason of the war, and this is of the utmost practical value, since otherwise we are in danger of misjudging developments by using pre-war and therefore obsolete standards, thus going wrong in our attempts to forecast.

From that viewpoint, the most salient feature in the course of trade in iron and steel in 1924 is the speed with which changes occurred in the rate of buying and the rate of production. The familiar swings in trade before the war were by no means uniform, but the average time from crest to crest of activity, or from trough to trough of depression, was about three years. The fourth crest after 1899 was in 1912.

In 1924 there was almost a round trip within the confines of a single year. In steel ingot production there were a crest and a trough only four months apart, and the crest of March, 1924, was only 11 months after the crest of April, 1923.

Thereby hangs a tale. It was no accident and no product, to any great extent, of outside influences over which the steel trade, producers, dealers and consumers had no control. No one claims now that the downward turn, which occurred in April, would not have occurred at all had it not been for the "oil scandals" at Washington which men tried at the time to make the scapegoat.

The quickness of the swings is due to the very large producing capacity, due to the war, and to changed policies in buying and selling steel, due in part directly to the war, in part to things that occurred after the war but in a sense as a result of it, and in part to other influences. It is not necessary to analyze these.

The two prominent facts are that the steel producing capacity is largely relative to the steel consuming capacity of the country, and that the custom in buying and selling steel has changed. To an extent the latter is the result of the former. The custom is not to buy or sell far ahead. Before the war contracts were frequently made which were not entirely completed for more than a year. Reference is not made, of course, to construction material which sometimes must be bought and sold far ahead. Contracts would be made between mills and jobbers or manufacturing consumers for quarterly periods, first for one quarter, then shortly for an additional quarter, and so on. Usually contracts were underspecified, and to insure full operation mills would oversell. Sometimes the contracts would be fully specified and then mills fell far behind in deliveries.

*Pittsburgh, Pa.

Nowadays sales are made but a short distance ahead, as a rule, and more commonly the business is in outright orders, for "shipment at mill convenience," or in contracts for short periods. The jobber or consumer has no occasion to "cover" far ahead as the probability is material will be obtainable when he chooses to order it.

A buying movement started in December, 1923. Under the old conditions the mills would have fallen behindhand in deliveries, prices would have tended to rise and the contracting would have proceeded with cumulative force. As it was, the mills limbered up with unprecedented rapidity, which was the more surprising seeing that they had recently abolished the 12-hour workday and that had been predicted to make a labor shortage should steel become active. The rate of steel ingot production in March, 1924, was 41 per cent above the rate in the preceding December, and was a new high rate for the steel industry, just a trifle over 50,000,000 tons a year. It is true the trade outlook then became less favorable, but it had previously been judged in too sanguine a spirit. Steel buyers found that they had overestimated their requirements and they also found, which is particularly to the point, that the deliveries were being made more quickly, or in greater volume, than had been expected when the orders were placed.

Then buyers promptly called a halt and started to liquidate. Steel ingot production the following July was 55 per cent under the March rate. In pre-war times there had been no such drop but once, and then it was a case of calamity, the panic of October, 1907. This time there was no business or financial occurrence of consequence. Consumption of steel did not change materially. Possibly it even increased a trifle. There was a quick though not large overstocking and a quick liquidation, so quick that before July was ended production was again on the upturn. The preceding low month was December, 1923.

Liquidation of really surplus stock had been accomplished by July. Perhaps stocks were then what may be called "normal," if there is such a thing. Afterwards there was very rigid reduction of stocks, up to the election of November 4. The election reassuring trade, replenishment towards normal began, and production continued increasing even in December, when ordinarily there is a falling off.

The lesson of these experiences is that as affairs are now aligned one cannot expect as long swings in steel as used to occur before the war. If demand and production increase a downward turn may come soon. If the business becomes depressed, it will take only a very short time to liquidate, and then trade will again be on the upturn.

Steel Prices.

Before the war it was a common opinion that when steel prices were down they could not be expected to advance until the steel industry was operating at 80 or 85 per cent of capacity, perhaps even more. A

really strongly advancing market could not be expected until there was practically capacity operation. When the operation of the steel industry dropped to 75 per cent or less price cutting was quite likely to occur. When a downward turn in buying occurred, mills would have a large volume of contract tonnage and would hold prices so as to encourage specifying on the contracts. When there was more chance of disposing of steel by outright sales at cut prices than by specifications on contracts prices would decline.

By the pre-war philosophy the steel industry would have been in an impossible position most of the time since the war, for an 85 per cent operation has been unusual and operations below 50 per cent have been common. The great principle of compensation has intervened. Mills observed that they could not follow the old rules or there would rarely be any profits, hence they refrained from price cutting under circumstances that would have provoked it before the war, and they advanced prices in circumstances which before the war would not have been considered ripe for an advance.

Advances once made become effective on shipments sooner than before the war, and that helps. As it is not customary to sell far ahead, a quarter's production or requirements at a time, a mill can try the experiment of advancing its prices. It loses little by staying out of the market for a time. In the old days it might miss a whole quarter's business in a few weeks, and when later it tried to sell it might find all buyers covered. Now there is always more or less chance to do business, and while the steel industry does not suffer from its large capacity it does much better in getting prices up than would have been expected from pre-war experiences.

Two Good Years.

Steel ingot production in the past six years, since the war, has been as follows, with 1924 estimated:

1919.....	33,694,795	gross tons
1920.....	40,881,392	" "
1921.....	19,224,084	" "
1922.....	34,568,418	" "
1923.....	43,485,665	" "
1924.....	36,500,000	" "

The high year of the six was 1923, falling just short of one previous year, a war time year, 1916. The year 1924 was 17 per cent lower, but there was not as great a difference in actual consumption of steel. There were small stocks at the beginning of 1923, as the steel making industry had just recovered from the effects of the 1922 coal strike, and there was thorough liquidation in 1924, but there were stocks of some consequence carried over from 1923 to 1924 in steel and in wares made from steel. As the interest in these things is to find a basis for looking forward, it may be just as well to take it that there have been two fairly good years as to industrial activity and steel consumption, represented approximately by an ingot production of 40,000,000 tons a year, this covering domestic consumption plus exports. The exports, while much talked of, represented only about 6 per cent of the production.

In our review of a year ago an argument was made to show that steel consumption in 1923 had been practically as heavy as could be expected, taking the best pre-war consumption as basis and allowing for increase in population, changes in methods of working,

etc. At that time there were predictions that 1924 would be a much better steel year than 1923 had been, but according to the analysis this seemed unlikely if not impossible, and the outcome justified the analysis.

We may now take the two years together, represented by 40,000,000 tons of ingots a year. Better business in general is now predicted not only for 1925, but for several years, and no fault can be found with that, for all the circumstances seem to support the view very fully.

The question is the quantitative outcome, what change can be expected from a 40,000,000-ton average. There has been very nearly full labor employment in the past two years, well above the average of a quarter or half century. If nothing were reasonable to surmise as to the future, the chances would be of lighter employment, but the definite prospects are for heavier employment. The increase can be no more than a few per cent, however. If the kind of work is unchanged, the consumption of steel will be in proportion to the total of employment, with an allowance, which cannot be large in a single year, for improvements in methods of consuming steel. The kind of work may change, but one cannot pick out many changes that will be in favor of steel. Building of freight cars has been heavy in the past two years and in few ways can workmen consume more steel than in building cars. Automobile production does not consume a great deal of steel. The number of cars built in the past two years has been very large, but the cars are lighter. Highway construction consumes relatively little steel, and there is likely to be much activity along that line in 1925. As to fabricated steel work, 1923 was a good year, and 1924 has been nearly 10 per cent better.

When the rate of steel ingot production reached 43,000,000 tons early in December, 1924, with very definite prospects of its going well above that rate early in 1925, it becomes difficult to believe that the further increased rate will be maintained indefinitely, or even for a year. There are likely to be short ups and downs as there have been since the war, and the total of 1925 may easily be above 40,000,000 tons.

Price Prospects.

Mills have become conservative both in advancing and in cutting prices, there have not been price swings synchronous with swings in buying and production. After a slight post-war decline there was an upward turn in prices with no downward turn until the latter part of 1920, and then the decline lasted until March, 1922, the subsequent upward turn coming to an end in April, 1923. The next upturn did not begin until November, 1924. There was a downswing for about 18 months, an upswing for almost 14 months, and then fully 18 months elapsed until the present upswing began after the presidential election. That 18-month period was a peculiar one, not plainly marked. Prices did not definitely decline for the most part, they just yielded or slipped almost insensibly, and not all commodities even did that. Rails, tin plate and pipe have not declined at all from the top level they reached in April, 1923. Realized prices average somewhat lower in pipe, and a trifle lower in tin plate, on account of the setting up of basing points outside of Pittsburgh pursuant to the Federal Trade Commission's order of July, 1924, against continuance of the "Pittsburgh plus" pricing system.

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The price advances in steel products in the last two months of 1924 represented the making of repairs to the price structure rather than a general lifting, and involved bars, shapes, plates, sheets and wire products. Further advances may occur in these lines early in 1925, without the former level being reached.

The different behavior of the various steel products in the matter of declines is also a relatively new thing in steel. In the old days prices had more tendency to move together. A decline in one line would tend to promote declines in other lines. Bars, shapes and plates moved very much together. A change in wire products was likely to affect sheets sentimentally. Of late it has been a case of every tub standing on its own bottom. There were more competitors in plates than in bars, and from April, 1923, to October, 1924, plates declined \$15 a ton or more while bars declined only \$8 or \$9. Skelp declined with plates and bars while pipe did not decline.

To put a fine point on it, there was in fact some indication of a reversal of the influence of one product on another. If a mill were making two products, to put it conventionally, and found market in one of the products weak, it would be all the more disposed to help support prices in the other product, so as to have something left out of which to make money.

Hot Top for Ingot Molds

By J. H. Hruska

Introduction.

It is a well-known fact that the ultimate costs of steel ingots of a given quality are usually governed by the cost of operation as influenced by the rate of production and that the consistent efforts to reduce cost of production require a thorough study even of all those factors which may not be considered as important as to be worthy of special attention. In the following lines the writer wishes to point out one of these "unimportant" factors which are usually overlooked in many plants, but which indirectly represent a very important point in the efficiency of every ingot producing steel work.

The Hot Top in the Regular Steel Works Practice.

The refractory and non-heat conducting property of the hot top brickwork serves, of course, to keep hot as long as possible the upper part of the freshly cast ingot, thus serving as a reserve of molten metal and as a means for minimizing piping in the ingots. The writer found by investigation the effect on molds for 2,400 lbs. ingots that the average output of sound ingot metal by the use of molds without a hot top was 60-76 per cent; when a hot top was used the output increased at 85-90 per cent. This large difference will be found of special importance when high grade alloy steel is manufactured; chromium, nickel-chromium, tungsten or vanadium steel should always be poured into molds with a hot top. If large forging ingots (10-120 tons) are to be produced it is understood that the upper parts with a greater cross section have to be fed with hot steel so that the use of the top is here more essential than anywhere else and the steel works should never take a risk by missing it. Thus the costs for the hot top per ton of produced ingot steel depend upon

- 1 weight of ingot
- 2 design of ingot
- 3 design of top
- 4 refractories used
- 5 labor

but are more than equalized by the increased output of sound metal.

Design of the Top.

To be useful, the design of a hot top has to cover some important proportions.

1. The volume of the top has to be dimensioned as to furnish sufficient molten steel into the growing pipe (usually 12-28 per cent of the total volume of the mold).
2. The effect of shape is less important than the volume of hot top. But as a rule there is always a little decrease in the cross section upwards. This decrease is desirable when the top is either removable or the molds have to be stripped off the ingots; the amount is 2-6 per cent (diametrically).
3. The top has to be square for square ingots and round for hexagon, octagon or round ingots.
4. The area of the average cross section of the hot top should be about 68-78 per cent of that of the ingot, the height 30-38 per cent.

Refractories.

The selection of refractories which have to be used for a hot top depends almost on these leading requirements:

1. Chemical analysis.
2. Thermal and mechanical properties.
1. The chemical analysis, as a factor to give the greatest length of service, should cover the normally present constituent parts and special care should be taken in the determination of refractoriness. As a rule, the minimum should be 3050 deg. F. (= 30 Seger cones or 1,670 deg. C.).

Good results showed bricks with the following analysis:

57.58%	SiO ₂
4.23%	Fe ₂ O ₃
37.75%	Al ₂ O ₃
.40%	MgO
Refractoriness: 3130	Deg. F.
1720	Deg. C.
33	Seger cones

2. After the ingot is cast into the mold, the time of cooling — especially of large forging ingots — must effect the lining of the top in a very extensive way. This effect will be better understood by considering the cooling time of ingots. The following table gives an average of some of the author's observations and also the time, where it is most effective to strip off the hot top.

Weight of ingot in tons.	Time necessary to cooling at 2-400° F. in hours.	Time to strip off the top in hours.
5.9	18 - 22	16 - 18
10.4	23 - 25	18 - 22
48.5	34 - 38	28 - 32
116.0	100	80

The latter numbers represent the best time to cool the thickest part of the ingot without any danger of getting cracks on the finished ingot, presumed that the steel was well deoxidized and cast at normal temperatures and speed.

(Continued on page 12)

The Relation of Machines to Labor Turnover

By RUSSELL B. WILLIAMS*

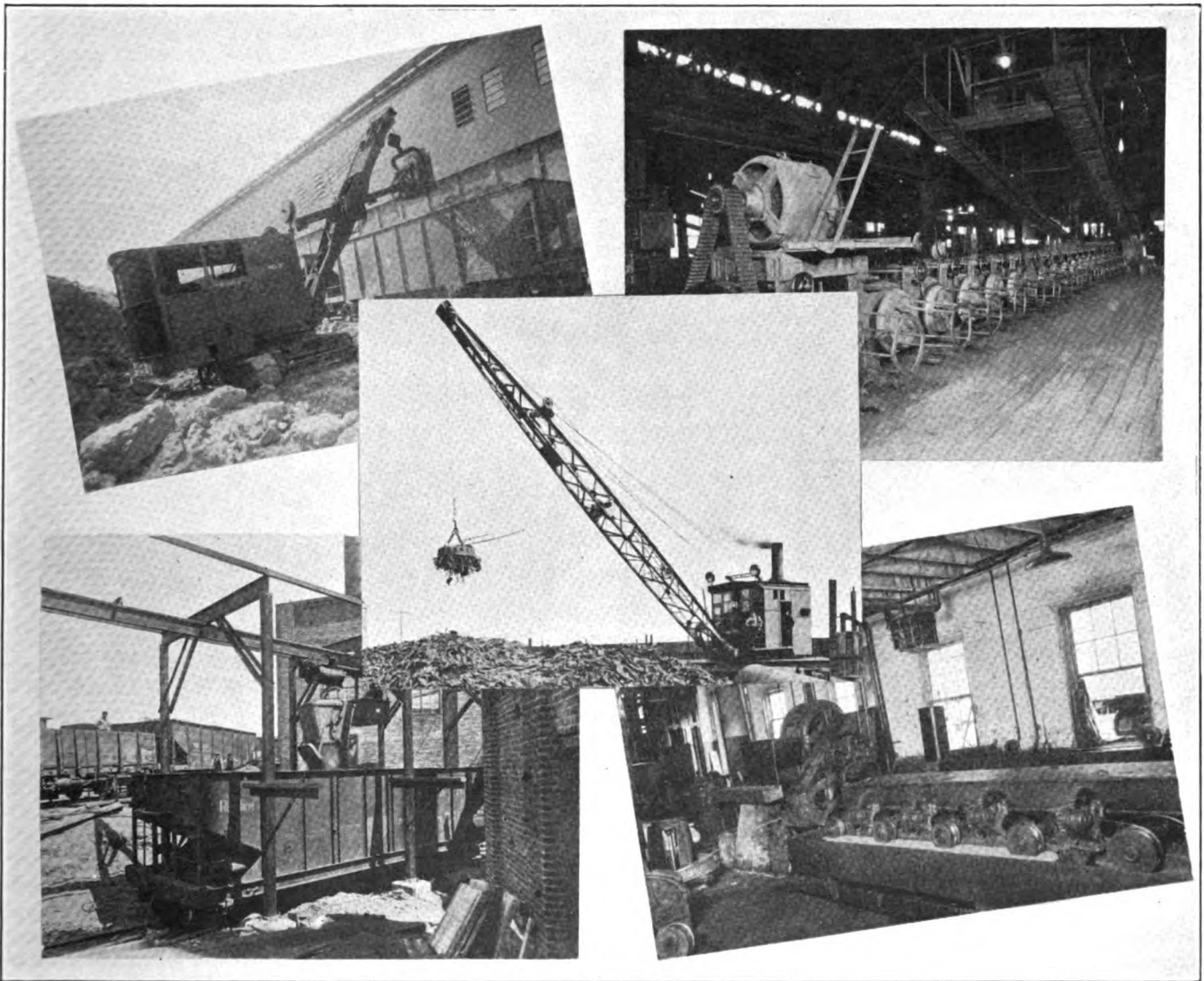
MUCH has been and is being said relative to the surmounting of present day excessive labor costs through the introduction of machines, more machines, and still more machines. Nor does the writer take issue with any of the arguments or suggestions so offered. Machines point the way to greater independence of that most expensive of all modern luxuries—common labor—at the same time making for increased production and lessened costs and fixed charges. This is proven in the fact that since 1900 the personnel of manufacturing industries has doubled, while the value of the fabricated is now six times the total as of 24 years ago.

It has always seemed to me, however, that merely stating that mechanical means "saved" labor was telling but half the story. Mechanical means do more than that. While lifting the drudgery of labor from the shoulders of the workingman and in effecting economies in labor costs, machines have done much to de-

crease that largely unknown, yet astonishingly expensive factor—labor turnover.

Saying only "machines instead of men" reminds me of the propaganda put out by the agricultural implement manufacturers at the time of the tractor's advent. So enthused were they over their product and the tractor principle in general that they played up (in their advertising and other sales effort) the great quantities of land necessarily devoted to the raising of hay and feed; the susceptibility of stock to flies, fatigue, disease and even death, thus resulting in a total loss. All of this had the coloring of truth. Indeed, it was truth concentrated on one angle of the farm power problem, which, unlike publicity (which sheds light on all sides of a question) and consequently was merely propaganda. And in spite of this concentrated truth and the real worth of the tractor principle, they failed to bring about a real horseless farm. Horses are necessary on farms today and doubtless will be for many years to come. And so it is with machinery. However successful in the elim-

*Chicago, Ill.

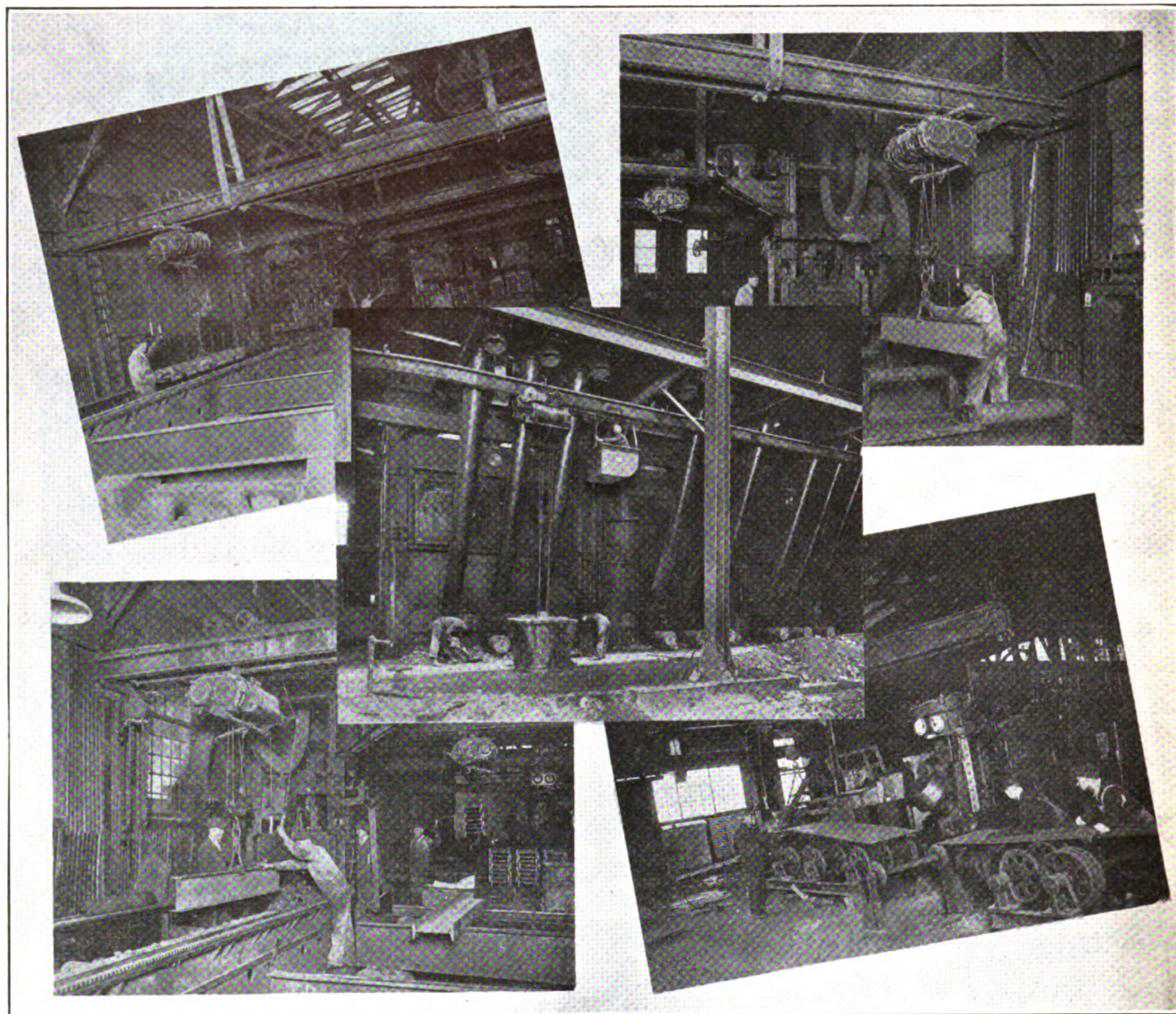


"Machines instead of men" is well illustrated by an analysis of the operations shown above.

ination of waste effort and motion is machinery, it cannot and probably never will, entirely supplant hand labor. There will always be the necessity for human labor in the fabrication of life's necessities and this simple, trite fact will not become inconvertible through automatization, at least in the present generation.

The makers of efficient material handling equipment and devices for the speeding up of production are overlooking the same fundamental worth of their devices that the tractor manufacturer failed to realize at the outset.

out these implements, the farmer lad and the "hired man" found agricultural pursuits irksome, prosaic, monotonous and uninteresting—subsequently leaving for what they believed to be "greener fields." With these devices—the automobile that speeds them through the community centers and into the county seat within an hour's time—the radio that brings to their ears the news, markets and amusements of the minute—and the tractor that gives to the tilling of the soil an added interest and ease—they are inclined to stay on the farm where they can prosper, both men-



Views taken during working hours in a variety of plants where chain blocks have become essential aids to production.

You will recall the "silk shirt" period of false prosperity that immediately followed the conclusion of the World War. It was in that period that the farmer's boy and the youths of the rural centers flocked, with alarming speed, to the cities where they believed it possible to participate in the high wages of the laborers, which were then at a level (and in some cases still are) all out of proportion to the service rendered. It was then that the farm tractor and other devices designed for the aid of labor, such as silos, automobiles, radio, etc., came into play. With-

tally and financially, at a more rapid rate than their city brothers.

And that same element—machines—can be made to increase the workman's morale and decrease the labor turnover. After all, the greatest problem confronting the management of any plant, mill or factory is that of creating the desire to work. If every industrial administration could accomplish that one thing—create the desire on the part of their employes to work, their turnover would be lowered to the irreducible minimum and a great deal of money, time

and effort could be expended on other and possibly more fruitful ends.

In considering the creation of desire for work we find three subconscious elements that effect such a desire. These elements are ventilation, light and noise. Without proper ventilation, physical endurance is cut down, which condition is reflected on the production charts. Light is an equally important factor in determining the productivity of human labor. Noise is a third element that subconsciously cuts down the efficiency of the workman, effecting both his own and his company's earning capacity. The betterment of any one of these three elements, or all of them, will do much towards bringing production to its maximum.

Consciously, workmen demand six major things, the absence of any one of which will materially contribute to labor turnover. The six elements are fair wages, harmonious surroundings, security of position, possibility for advancement, scope for self-expression and inspiring leadership.

It will be seen immediately that the application of machinery to these elements will not, in any way, have anything to do with the last and more important factor, inspiring leadership. (It is a regrettable characteristic of many executives who have to hire fire and inspire, that the last named duty is often overlooked). Machinery can, however, effect all other factors.

To the end of illustration we will take the experience of an industrial engineer for a large Chicago steel products concern. Practically all of his workmen operate on what they know to be a "quota basis." That is, each man is given a stipulated amount of work to do in a given period. His production, over and above that quota, warrants him increased compensation; hence the interest of the workman lies in how much he can produce over a certain amount, for he realizes that the "over-production" brings a higher rate of pay than that which is under his established quota.

For several months his punch press operators had been grumbling because they found it impossible to get into their "quota money." They could not meet and go above their quota. Because of this many of them felt that they were not receiving sufficient compensation and quit to find work elsewhere. This condition continued until the labor turnover in that particular department reached alarming heights and was beginning to affect the morale of other departments. Motors, machines, line shafting and pulleys were examined thoroughly but yielded no cause for the decreased production. Finally the matter of belt slippage was studied, which was found to be losing more than fifteen per cent of the power generated. The ample power of the motor was not reaching the machines. Silent chain drives were installed forthwith, with the result that not only was the production of the department increased fifteen per cent, but the men were then in a position to positively control the speed at which their individual machines operated and to go over their quota every month — doing what they termed "getting into the extra money."

Here we find the two elements of "fair wage" and "scope of self-expression" brought within reach of the workingmen through the introduction of a device that would utilize every ounce of power generated by eliminating slippage. With the possibility for faster work and "self-expression" comes "security of position"

and "possibility for advancement." There remained for that department only the one element that machines cannot provide—"inspiring leadership." And that factor I will not deny my engineer friend for he was, truth to tell, a true executive.

Not long ago I attended a dinner given by several Cleveland steel producers. I believe the dinner was a regular function, carried forward periodically, and at which round-table discussion of business problems were in order. While there, one of the producers told me what a similiar change in mechanical equipment had done for his men. Prior to the silent chain installation this firm had employed a rope drive. And rope drives, while they can go around corners and have other features in their favor, do take up a great deal of room. The change in power transmission was made for economical reasons only. However, after having made the silent chain installation he found that the space formerly allotted to housing the bulky transmission was now "surplus equipment." The space thus released was immediately converted into a wash-room for the men. It is now a source of pride to the company, and a thoroughly appreciated convenience for the men.

Chicago is nearly, if not fully as bad as Pittsburgh in the matter of smoky, sooty atmosphere. Almost every office building must be cleaned once a year, both externally and internally, if it is to be considered "clean." Following precedent, the executive and administrative office of one of Chicago's large steel companies are redecorated annually—and at considerable expense. Calcimining is employed, the decorative substance being applied by painters and large 8-in. brushes. This work formerly required the time of eight painters, equipped with pails, scaffolds, canvas and all the other cluttering paraphernalia that it seems necessary to have. And the time required for the work was one day to the floor. There being four floors to the general office, this work required the time and labor of eight painters for four days. Further, their presence completely disrupted office routine. It was necessary to move all desks to the center of the offices, cover them with a large canvas (none too clean in itself) erect the scaffold, do the work of re-decorating, remove the ladders and canvas, then readjust and clean the office fixtures. The result of this method was so disagreeable that it was found economical to declare a holiday for the entire floor force during the time such decorating was being carried on. This contributed handsomely to the cost of the work.

Now this work is performed in a day and a half (Saturday afternoon and Sunday) by three painters equipped with compressed air spray paint guns. The economies effected by the change in practice will be instantly apparent. Absolutely no disruption of office procedure. And three painters for one and one-half days (even at double time for "overtime") is somewhat different than eight painters for four or five days. It has been found also that in covering the walls with calcimine via the spray gun effects a saving of nearly one-third the amount of paint used. The old, slow brush method, it has been proved, is not only expensive in time and labor but exceedingly wasteful of paint.

Supplanting common or semi-skilled labor, so far as possible, through the introduction of mechanical means is the most advisable step any producer can make, not only for the present, but for the future. In

times of labor shortage it behooves every employer to take particular pains to create the desire to work on the part of his employes. As at present, when business conditions are only "fair" and when unemployment is on the increase, there is greater opportunity afforded the employer to stimulate the desire to work by reason of the fact that, unfortunately, the law of supply and demand materially effects a workman's efficiency. If he knows "jobs" are hard to get, he will be more particular about the one he now holds. Workmen in general are of that mind today—which makes the adoption of mechanical means all the more simple and justifiable.

Much can be done toward the creation of the desire to work by the elimination of detrimental elements and the application of machinery and labor-aiding devices. Not only will certain devices effect ventilation, light and noise of a plant, but in almost every case will heighten the five of the six conscious elements. The sixth—that of inspiring leadership—depends entirely upon your ability. The other five (or eight) remain only on your will.

Holland's First Blast Furnace

By A. C. Blackall

Known as the Dutch Blast Furnaces & Steel Works, Ltd., a new enterprise has just put into operation the first blast furnaces in Holland.

The great importance of this event from an economic point of view will readily be seen when it is understood that the Dutch iron-working industry, the importance of which is generally much under-estimated abroad, in 1921 employed 68,000 workers in 592 different concerns. Approximately 50,000 tons of raw iron and considerably more than 200,000 tons of steel billets, bar, hoop and sheet iron, etc., are handled by these enterprises.

Owing to the many difficulties experienced in obtaining the necessary requirements of iron and steel during the war, the erection of blast furnaces on the coast, working with Swedish or Spanish ores, was decided upon. The new works are erected at Ymuiden—the outer port of Amsterdam—which city has promised a participation of 5,000,000 florins (normally \$2,010,000) entirely apart from the 7,500,000 florins (\$3,015,000) invested by the Dutch government. In the remaining 30,125,000 florins capital, consisting of 29,500,000 florins (\$11,859,000) 90 per cent paid up and 625,000 florins (\$251,150) fully paid, practically all the principal banking, shipping, industrial and general trading concerns are participating.

The blast furnaces have an estimated annual production of 100,000 tons, and have been erected on the American system according to designs supplied by an American firm. They were constructed by two closely connected firms working in conjunction—the Phoenix A. G. für Burgbau und Huettenindustrie and the Guteheffnung-shutte. A further arrangement was also made with the Phoenix Company, which undertook to deliver cast-iron in return for German rolled iron products. As the new enterprise also anticipates the sale of its products outside Holland, it is thought the wide experience of the Phoenix Company will serve it in good stead.

The company owns extensive limestone deposits in Belgium from which it will receive all necessary supplies of lime. In order to be able to provide immediately a portion of Holland's demand for steel (the construction of its own steel plant not yet having been completed) an interest in a small Dutch steel foundry has been acquired. The erection of a cement factory for the utilization of the slag is also contemplated.

Reaches the Century Mark

The Pittsburgh Electric Furnace Corporation has contracted for its one-hundredth furnace in the United States and Canada. It is interesting to note the gradual increase in the number of Moore furnaces or, as later known, the Moore 'Lectromelt furnace installations in this country, the record being as follows:

1917	3
1918	8
1919	15
1920	26
1921	40
1922	57
1923	78
1924	100

During 1924 repeat orders were had from such concerns as the American Manganese Steel Company, General Motors Corporation and Wm. Cramp & Sons Ship & Engine Building Company.

A recent contract with the American Manganese Steel Company calls for three 3-ton holding capacity 'Lectromelt furnaces, making a total of six of this size furnace purchased by the American Manganese Steel Company.

In addition, the Pittsburgh Electric Furnace Corporation has installed four furnaces in Europe, one in China, one in South America and one in Mexico. The company has also handled three installations of furnaces of special types in this country other than the standard steel and gray iron melting furnaces which they manufacture.

During the past year the 'Lectromelt data exchange has been put into operation. This data exchange has proven very valuable to the furnace user in that monthly reports on operating figures are had from the various companies using the equipment and every quarter a composite table is made up listing the quarter's average figures from each plant. Separate composite tables are made up for each size furnace and the user receives the composite table for the quarter applying to the particular size furnace which he is operating. This table has enabled furnace users to compare their operating economies with a number of other furnace users of the same size and type equipment. The plant name is, of course, not given, the various companies being listed under the letters of the alphabet. The table is operated on a confidential basis, being available only to users of the particular size furnace covered by the table. No attempt is made in the table to go into the question of cost of castings, the table covering such questions as kilowatt hour consumption per ton, electrode consumption, demand, tonnage output, maximum and minimum weight of castings poured, and refractory life. The net result of the introduction of a table of this sort has been corrected practice in a number of plants and to bring operations to a more or less average level.

It is interesting to note that the past year's business of this company has included a number of furnaces going into the gray iron and malleable iron field. This is a work in which the electric furnace is comparatively new but in which there is widespread interest.

Review of Iron and Steel Literature for 1924

By E. H. McCLELLAND*

THIS list constitutes the eighth annual review of iron and steel literature compiled for the Blast Furnace and Steel Plant. An attempt has been made to list the more important publications of 1924, together with certain publications dated 1923 but not available for inclusion in the list compiled near the end of that year.

Where possible, the compiler has examined the publications listed, but in some cases the publications were not accessible and the only information regarding them was in technical journals and publishers' lists, which, unfortunately, are not always either accurate or complete. Prices are sometimes particularly hard to verify promptly, certain sources of information occasionally differing very widely. The prices here given are, therefore, probably in some cases incorrect. German prices, quoted in marks, refer to the "goldmark", equivalent to 10/42 of a dollar.

Much of the best information on ferrous metallurgy, is found in bibliographies and articles in technical and trade journals. The best guide to this scattered material is the "Journal of the Iron and Steel Institute", two current volumes of which are listed below. A "Bibliography of Manganese Steel", compiled by the Technology Department of the Carnegie Library of Pittsburgh, and published in the December, 1924, issue of the Blast Furnace and Steel Plant, is now being reprinted for free distribution by the Library.

GENERAL

Geology, Ores, Mining.

L'Association minière d'Alsace et de Lorraine. Note sur l'industrie minière en Alsace et en Lorraine, 1922-23. 105 pp. 1924. The Association, Metz.

Bayley, W. S. Magnetic Iron Ores of East Tennessee and Western North Carolina. 252 pp. 1923. Nashville, Tenn. (Tennessee—Division of Geology. Bulletin 29.)

Prepared in co-operation with the U. S. Geological Survey, the North Carolina Geological and Economic Survey, and the Geological Survey of Tennessee.

Colony, R. J. Magnetite Iron Deposits of South-Eastern New York. 161 pp. University of the State of New York, Albany.

Oglebay, Norton & Company. Lake Superior Iron Ores. 31 pp. 1924. Cleveland, Ohio.

Analyses, with guarantees for 1924.

Pickands, Mather & Company. Cargo Analysis, Lake Superior Iron Ores. 19 pp. 1924. Cleveland, Ohio.

Société d'Etudes pour l'Utilisation des Gisements de fer suisses. Untersuchungen zur Klärung der Frage der elektrischen Verhüttung Schweizerischer Eisenerze. 48 pp. Verlag Stahleisen, Duesseldorf. \$1.20.

Metallurgy, Testing.

Akademische Verein Huette. Huette; manuel de l'ingénieur métallurgiste. Translated from the second German Edition by Charles Hermann. 1062 pp. Ch. Béranger, Paris. 60 fr.

Bagnall-Wild, R. K. Notes on Iron and Steel. 52 pp. H. M. Stationery Office, London. 1 sh. 6 d.

Bicheroux, F. Principes de siderurgie. Ch. Béranger, Paris.

*Technology Librarian, Carnegie Library of Pittsburgh, Pittsburgh, Pa.

Calorizing Company. The Calco Handbook of Recuperation. 1924. The Company, Pittsburgh. \$3.

Loose-leaf volume dealing with combustion, and the possibilities in fuel economy with the equipment manufactured by the publishers.

England—Research Department, Woolwich. Properties of Medium Carbon Steel with High Manganese Content. H. M. Stationery Office, London. (Report No. 61.)

Fremont, C. Essai mécanique des tubes acier. 52 pp. 1923. 25 rue de Simphon, Paris.

Galassini, Alfredo. Elementi di tecnologia meccanica e di siderurgia. Ed. 2. 725 pp. Soc. tip. ed. Nazionale, Turin. 80 lire.

Harbord, F. W., and Hall, J. W. Metallurgy of Steel. Ed. 7. 2 vols. Charles Griffin & Co., London. 32 sh. each.

Vol. 1. Metallurgy, by F. W. Harbord. 545 pp.

Vol. 2. Mechanical Treatment, by J. W. Hall. 553 pp.

The standard British work. In volume 1 the matter relating to the production of steel in the electric furnace has been largely rewritten, and the sections dealing with special and high-speed steels, heat treatment, etc., have been brought into line with latter-day practice and much extended. Vol. 2 has been practically rewritten throughout. Hitherto the work has been published in a single volume.

Harper, L. F. Iron. 23 pp. 1923. (New South Wales. Department of Mines. Geological Survey. Bulletin 4).

Brief survey of resources, early attempts at manufacture, and present status of the industry.

Hermanns, Hubert. The Planning, Erection and Operation of Modern Open Hearth Steel Works. 307 pp. 1924. Ernest Benn, London. 42 sh.

Considerable attention to American practice.

Heyn, E. Theorie der Eisenkohlenstoff-Legierungen. Julius Springer, Berlin.

Iron and Steel Engineer. Monthly. Vol. 1—date. January 1924—date. Association of Iron and Steel Electrical Engineers, Pittsburgh. \$5 a year.

A new journal, superseding the A. I. & S. E. E. Monthly Issue. Devoted to the interests of the steel-mill engineer.

Iron and Steel Institute. Carnegie Scholarship Memoirs. Vol. 13. 294 pp. 1924. The Institute, London.

Iron and Steel Institute. Journal. Vol. 108, 534 pp. 1923. Vol. 109, 679 pp. 1924. The Institute, London.

Koegler, F. Taschenbuch fuer Berg und Huettenteute. 1493 pp. 1924. Wilhelm Ernst & Sohn, Berlin. 21 m.

Kommers, J. B. Comparative Tests of New Billet Steel and Rolled Steel Reinforcing. 1924. Univ. of Wisconsin—Engineering Experiment Station, Madison, Wis. 30 cents.

Korevaar, A. Combustion in the Gas Producer and the Blast Furnace; a New Theory. Crosby Lockwood and Son, London. 15 sh.

Krug, Karl. Die Praxis des Eisenhuettenschmieds. Ed. 2. 1923. Julius Springer, Berlin. \$1.70.

Ledebur, A. Handbuch der Eisenhuettentechnik. Ed. 6, revised by Hans Freiherr von Jueptner. Part 1. Einführung in die Eisenhuettentechnik. 556 pp. 1923. Arthur Felix, Leipzig. \$4.

Mathesius, Walther. Die Physikalischen und chemischen Grundlagen des Eisenhuettenwesens. Ed. 2, revised. 483 pp. 1924. Otto Spamer, Leipsic. 30 m.

Written from the standpoint of the engineer.

Osann, Bernhard. Lehrbuch der Eisenhuettenkunde. Vol. 1. Roheisenerzeugung. Ed. 2. 923 pp. 1923. W. Engelmann, Leipsic.

Parkesburg Iron Company. Parkesburg Tubes Are Real Charcoal Iron Boiler Tubes. 52 pp. 1923. Parkesburg, Pa.

Booklet (with above title on cover) illustrating and briefly describing manufacture of boiler tubes.

Pavloff, M. A. Calcul du lit de fusion des hauts-fourneaux; translated from the second Russian edition by L. Dlouatch. 178 pp. 1924. Dunod, Paris. 22 fr.

Pavloff, M. A. Metallurgy of Iron (in Russian). 180 pp. 1924. Scientific Technical Dept., Leningrad.

Pulsifer, H. B. Structural Metallography. 210 pp. 1924. Chemical Publishing Co., Easton, Pa.

Savioa, U. Metallurgia generale e siderurgia. Ed. 2. 535 pp. 1923. U. Hoepli, Milan. 30 lire.

Schwarz, M. von. Eisenhuettenkunde. Vol. 1. Das Roheisen. G. J. Goeschen, Berlin. (Sammlung Goeschen, v. 152.)

Stier, A. Die Stahle in den Metall-Vorgaengen. 148 pp. Max Jaenecke, Hannover. 2.70 m.

Thomas, W. Norman. Effect of Scratches and of Various Workshop Finishes upon the Fatigue Strength of Steel. H. M. Stationery Office, London. 3 sh. (Aeronautical Research Committee Reports and Memoranda, No. 860.)

Verein deutscher Eisenhuettenleute. Gemeinfassliche Daristellung des Eisenhuettenwesens. Ed. 12. 661 pp. 1924. Verlag Stahleisen, Duesseldorf. 12 m.

Economics, Statistics, Directories, History.

American Society for Steel Treating—Pittsburgh Chapter. Who's Who in the Pittsburgh Chapter, American Society for Steel Treating. n.p. (1924.) Pittsburgh.

Directory of local membership.

Andresen Company, Inc. Directory Giving List of Companies Operating Blast Furnaces, Steel Plants, Rolling Mills and Allied Industries; Forging and Stamping Plants in the United States and Canada, together with List of Executives and Operating Officials. 242 pp. 1924. Pittsburgh. \$5.

Ashton, Thomas Southcliffe. Iron and Steel in the Industrial Revolution. 265 pp. 1924. Longmans, Green & Co., London. 15 sh.

History of the iron industry in England, 1700-1815.

Birkett, M. S. Ferrous Metals of the British Empire. 165 pp. Ernest Benn, London. 21 sh. (Resources of the Empire Series, Vol. 8, Part 1.)

General information regarding the iron and steel industry of the British Empire. One of a series of volumes under the general editorship of the Federation of British Industries.

Boucher, John N. William Kelly; a True History of the So-Called Bessemer Process. 257 pp. 1924. The Author, Greensburg, Pa.

"Not only the romance of the life of William Kelly, but also the early history of manufacturing of iron and steel, Andrew Carnegie's life work, and finally Pittsburgh, as the iron and steel city; are told more or less in detail." *American Industries*, Nov., 1924, p. 33.

British Iron and Steel Companies, 1924. n.p. 1924. Business Statistics Company, Ltd., Cardiff. 2 sh. 6 d.

Pamphlet listing securities of iron and steel companies. Gives very brief financial statement and is apparently limited to the more important companies in the British Isles.

Burchard, Ernest F., and Davis, H. W. Iron Ore, Pig Iron and Steel in 1922. Published January 25, 1924. Government Printing Office, Washington, D. C.

Advance publication of pp. 341-376 of the United States Geological Survey's "Mineral Resources of the United States, 1922," Part 1.

Johannsen, Otto. Geschichte des Eisens. 246 pp. 1924. Verlag Stahleisen, Duesseldorf. 20 m.

Metal Industry (London). Metal Industry Handbook for 1924. 293 pp. 1924. London.

Information regarding properties and treatment of metals and alloys. The 1924 edition contains for the first time a section dealing with cast-iron and steel. Much of the information is in the form of tables.

Metal Statistics, 1924. Annual ed. 17. 528 pp. 1924. American Metal Market Co., New York. \$1.

Mineral Industry; Its Statistics, Technology and Trade During 1923. Vol. 32. 887 pp. 1924. McGraw-Hill Book Co., New York. \$12.

On pages 332-385 Edwin F. Cone reviews the steel industry for 1923.

National Federation of Iron and Steel Manufacturers. Statistics of the Iron and Steel Industries, 1922. 90 pp. (1924.) The Federation, London. 5 sh. 6 d.

Figures for various countries extending over several years, but in most cases ending with 1922.

Niebuhr, Heinrich. Die Reorganisation der englischen Eisenindustrie. 138 pp. 1923. Walter de Gruyter & Co., Leipsic. 4.50 m.

Ryland's Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades Directory. Ed. 17. 1924. Eagland & Co., London. £2 2 sh.

Selwyn's Iron and Steel Code. 426 pp. James Selwyn & Co., London. £6 6 sh.

Electrometallurgy and Other Applications of Electricity.

Allgemeine Elektrizitaets-Gesellschaft. Elektrizitaet im Eisenhuettenwerk. 240 pp. 1923. Berlin.

Borchers, W. Die elektrische Oefen; Erzeugung von Waerme aus elektrischer Energie und Bau elektrischer Oefen. Ed. 4, revised. 238 pp. 1923. Wilhelm Knapp, Halle a. S.

Russ, E. F. Die Elektrostahloefen. 471 pp. 1924. R. Oldenbourg, Munich. \$3.75.

"As a compilation of data on electric furnaces or as a reference book useful to a patent attorney the volume can hardly be excelled." *Electrical World*, June 14, 1924, p.1247.

Sisco, Frank T. Manufacture of Electric Steel. 304 pp. 1924. McGraw-Hill Book Co., New York. \$3.

Discusses both acid and basic processes and deals with practical operation of furnaces.

Foundry Practice, Forging.

Corbishley, Harold. Iron Foundry Practice; a Technical Volume Covering Broadly the Modern Practice in Iron Founding of Special Value to Students and Apprentices. 271 pp. 1924. Funk & Wagnalls Co., New York. \$2.

Faraday Society. Fluxes and Slags in Metal Melting and Working. 1924. The Society, London. 7 sh. 6 d. A valuable collection of papers.

Galassini, Alfredo. Corso di fonderia. 688 pp. 1924. Soc. tip. ed. Nazionale, Turin. 75 lire.

Jones, Lynn C. Forging and Smithing; a Book for Schools and for Blacksmiths. 211 pp. 1924. Century Co., New York. \$1.50.

Elementary text on practical methods.

Mehrtens, J. Deutsches Giesserei-Taschenbuch. 479 pp. 1923. R. Oldenbourg, Munich.

Needham, W. Roland. Foundry Work. 146 pp. 1924. Blackie and Son, London. 2 sh. 6 d.

A primer, written especially for apprentice molders. The wording and illustrations are of the simplest character.

Osann, Bernhard. Leitfaden fuer Giessereilaboratorien. Ed. 2, revised. 1924. Julius Springer, Berlin.

Patek, P. Gesenkbau; Elemente fuer das Schmieden unter Presse and Hammer. 62 pp. A. Hartleben, Vienna.

Penton's Foundry List. 1925 Ed. 700 pp. 1924. Penton Publishing Co., Cleveland. \$25.

A directory of American foundries.

Wilson, John McC. Pattern-Making. 140 pp. 1924. 3 sh. 6 d.

A useful little work, attempting to treat those subjects which a beginner should require in the first five years of his training.

Refractories.

American Electrochemical Society. Refractories for Electric Furnaces. Ed. 2, 94 pp. The Society, Columbia University, New York. \$1.

"The original edition of this book was a report of the proceedings of the Electric Furnace Association and included papers presented at one of its meetings together with stenographic record of the discussion. Additional papers, specially prepared, have been included in the present edition." *Chemical and Metallurgical Engineering*, July 28, 1924.

Ennos, F. R., and Scott, Alexander. Refractory Materials, Fireclays; Analyses and Physical Tests. 84 pp. 1924. H. M. Stationery Office, London. 3 sh. (Special reports on the mineral resources of Great Britain. Vol. 28).

Refractories Manufacturers Association. Brands of Fire Brick and Other Refractories. Ed. 5. 48 pp. 1924. 2202 Oliver Building, Pittsburgh.

Trade names of refractories, with a list of manufacturers in the United States and Canada.

Corrosion, Galvanizing.

Calcott, William Stansfield, and Whetzel, J. C. Monograph on Corrosion Tests and Materials of Construction for Chemical Engineering Apparatus. 182 pp. 1923. D. Van Nostrand Co., New York. \$3.

Reprinted from vol. 15, pt. 1 of the Transactions of the American Institute of Chemical Engineers. The greater part of the book is a report by Calcott and Whetzel, on laboratory corrosion tests by E. I. du Pont de Nemours & Company. The latter is a paper by Harold F. Whittaker, on "Materials of Construction for Chemical Apparatus." The reprint is provided with an index.

Cuinat, H. Manuel de ferblanterie-zinguerie, cuiverie et tolerie. 295 pp. J. B. Billière et fils, Paris. 12 fr.

Massenz, A. Ricettario pratico di metallurgia. Finitura e preservazione delle superfici metalliche. Ed. 2, revised. 384 pp. U. Hoepli, Milan. 16 lire.

Polansky, Victor S., comp. Pickling of Iron and Steel; a Bibliography. 44 pp. 1924. Carnegie Library of Pittsburgh, Pittsburgh. Free.

List of more than 300 references, classified under such headings as: Machines and Equipment, Pickling in Acid Solutions,

Pickling in Salt Solutions, Electrolytic Pickling, Inhibitors and Accelerators, Effect of Pickling, and Recovery of Spent Liquors. Appeared serially during 1924 in "The Blast Furnace and Steel Plant," and "Forging-Stamping-Heat Treating."

Structural Steel.

Dencer, F. W. Detailing and Fabricating Structural Steel. 511 pp. 1924. McGraw-Hill Book Co., New York.

Steel manufacturers will find material on the forge shop and on rust prevention, and brief information on shop inspection.

Schaefer, Rudolf. Die Konstruktion Staehle und Ihre Waermebehandlung. 370 pp. 1923. Julius Springer, Berlin. 15 sh. 6 d.

Skelton, R. A., & Company. Structural Steel Handbook, No. 19. The Company, London. 5 sh.

Stahlwerks-Verband A. G., Duesseldorf. Eisen im Hochbau. Ed. 6, revised. 582 pp. 1924. Julius Springer, Berlin. 12 m.

UNITED STATES GOVERNMENT PUBLICATIONS

The publications listed below may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

UNITED STATES BUREAU OF STANDARDS

Scientific Papers.

No. 484. Preparation and Properties of Pure Iron Alloys. Pt. 4: Determination of the Critical Ranges of Pure Iron-Carbon Alloys by the Thermoelectric Method, by J. F. Berliner. 347-356 pp. 1924. 5 cents.

Technologic Papers.

No. 246. Wet Process Enamels for Cast Iron, by R. R. Danielson and H. P. Reinecker. 695-735 pp. 1923. 10 cents.

No. 252. The Nick-Bend Test for Wrought-Iron, by Henry S. Rawdon and Samuel Epstein. 115-155 pp. 1924. 10 cents.

No. 258. Strength of Steel Tubing under Combined Column and Transverse Loading, Including Tests of Columns and Beams, by Tom W. Greene. 243-276 pp. 1924. 15 cents.

No. 261. Influence of Sulphur, Oxygen, Copper and Manganese on the Red Shortness of Iron, by J. R. Cain. 327-335 pp. 1924. 10 cents.

No. 263. Tangent Modulus and the Strength of Steel Columns in Tests, by O. H. Basquin. 381-442 pp. 1924. 20 cents.

UNITED STATES BUREAU OF FOREIGN AND DOMESTIC COMMERCE

Trade Information Bulletins.

No. 186. Trade Organizations in French Metallurgy, by Chester Lloyd Jones. 10 pp. 1924.

No. 237. Italy's Foreign Trade in Iron, Steel and Nonferrous Metals in 1923, by A. A. Osborne. 6 pp. 1924.

No. 265. Austrian Iron and Steel Industry and Trade, by E. M. Zwickel. 19 pp. 1924.

Community Trade Mark for Sheffield

By A. C. Blackall

The distinction of being the first city to obtain the registration of a community trade mark has gone to Sheffield (England). The decision is considered important in that it establishes a precedent and similar registrations will probably follow in the case of other communities which in their trade or manufacturers have not forfeited a claim to represent specific manufactures associated with a particular district or community.

Sheffield has for long suffered from the wrongful use of the word "Sheffield," especially in the manufacture of cutlery and razors, and this grievance has become aggravated since the war by the re-entry of Continental competition. Germany in particular has been an offender in this connection and the years immediately following the Armistice saw the dumping in England of huge consignments of German small steel manufactures (particularly pocket knives, razor blades and cutlery of all descriptions) wrongly stamped "Sheffield." In most cases the misuse of the word has been made by foreign concerns and not by rival manufacturers in other parts of the United Kingdom. In a few cases, also, unscrupulous factors have marked "Sheffield" on imported goods factored in Sheffield.

The registration will strike direct at any misuse of this word on manufactured goods and will confer the right of instituting civil or criminal proceedings against offenders. The registration has been secured by the Cutler's Company, an association of which all the leading cutlery manufacturers of Sheffield are members. This association has always been zealous in its defense of the good trading and manufacturing name of Sheffield.

Link-Belt Puts Out New Malleable Iron Safety Collar

It is estimated that 10 per cent of the power generated in the average industrial plant is wasted between the generator and the consuming machine. Attention to this loss of power has given rise to changes in power transmission equipment and the development of more efficient mechanical means.

One of the most recent developments along this line comes from the Link-Belt Company of Indianapolis—the device illustrated by the accompanying photographic reproduction. This new Safety Collar is intended to maintain the proper alignment of such equipment as pulleys, shaft bearings, hangers, etc.

Great strength, toughness, durability and light weight have all been incorporated in this new Malleable Iron Safety Collar, in addition to which a new design which permits the collar to be split in two pieces, thus affording ready and economical installation or adjustment. This type of collar, however, is made also in the solid ring type, both types being accurately machine finished, assuring a tight fit and a pleasing appearance.

Exhaustive tests made with the Link-Belt Safety Collar have proven it to be impervious to shocks and strains encountered in heavy duty service. The material of which it is made possesses unusual wear and rust-resisting qualities. This extends its sphere of usefulness to installations where the atmospheric conditions contribute to rust or excessive abrasiveness. The set screw, by which the collar is firmly affixed to the shaft, is flange protected.

As with the recently perfected "Kex-Top" Grease Cup, the Link-Belt Malleable Iron Safety Collar will be marketed through dealers located throughout the country, thereby assuring prompt service and shipment.

Annual "Schools" for Salesmen

During the course of a year any large organization finds it necessary to add new men to the sales force. These new men, regardless of their previous experience or training, must be coached in company policies and standards of practice. They must be educated as to machinery design and construction before success as a salesman can be expected from any one of them.

Realizing that this education and training is most expensive and that at best it can be accomplished only over quite a period of time, the Link-Belt Company has adopted the policy of holding annual sales schools. The most recent of these schools was held at the Link-Belt Indianapolis factory, May 5 to 8, inclusive. The salesmen, 19 in number, came from Boston, Philadelphia, Toronto, Pittsburgh, Cleveland, Detroit, Chicago, Seattle and Indianapolis offices. This school was addressed by several of the company's officials, among whom were Alfred Kauffmann, vice president in charge of the Indianapolis works; Julius S. Holl, advertising manager, and a number of others.

Not only does this "school" permit the men to see and inspect the various malleable, steel and silent chain plants, and meet the officers and department managers, but the interchange of ideals among the men themselves, coming as they do from such widely separated points, makes for better feeling, fraternity and a dissemination of valuable sales information.

George Torrence, sales manager, with headquarters at Indianapolis, said with regard to this school: "This is the fourth annual sales school we have conducted and the value of such schools becomes more apparent each year. The men are inspired and benefited by their four-day association with the factory and home-office men and the increased volume of sales resulting from the men who have attended our schools have shown us conclusively that they are a paying investment from a dollars and cents standpoint. And this is aside from the intangible, yet great, value obtained through the better understanding and the clearer perspective naturally concomitant with such a gathering."

Hot Top for Ingot Molds

(Continued from page 4)

Before the steel is perfectly solid, there is always considerable pressure of the molten or solidifying metal against the brickwork of the top under high temperatures. Therefore it is essential that the refractories should be selected also under consideration of this point.

Life of the Lining.

As indicated, there are many factors to be considered in the economic selection of the refractories used for the lining of hot tops of ingot molds. The most essential requirement is to use the refractories over and over again until the corroded or otherwise damaged brickwork makes it necessary to reline the top with fresh bricks. This depends not only on the quality of the bricks but also on the care with which the ingot molds are handled. Under normal conditions the relining of the hot top has to be done after 10-20 or sometimes even more heats. Large ingot mold tops have to be repaired with convenient fire-clay after each heat and thus their life is very often much longer than previously indicated.

CURRENT REVIEW

Excerpts from the Steel Trade Weeklies

Production of pig iron in November totaled 2,513,247 tons compared with 2,461,727 tons in October, the November production being at the rate of 30,500,000 tons annually, in contrast with 29,000,000 tons in October. This was the fourth consecutive monthly gain in pig iron output. The number of active furnaces was increased by 21, the total at the end of the month being 203.

Lake Superior iron ore production for the season of 1924 totals 43,900,000 tons, compared with 60,780,003 tons in 1923 and 43,990,096 tons in 1922. Reduced stocks at furnaces and mines and accelerated furnace operations, lead ore producers to forecast a shipment of around 60,000,000 tons in 1925.

Production of steel ingots in November amounted to 3,107,226 gross tons, compared with 3,111,452 tons. November's production was the largest since April. Pig iron shipments are particularly heavy for this time of year and in the Chicago district some scarcity of iron is reported.

Sales of sheets in November by the independent mills increased to 460,709 tons, compared with 221,773 tons in October. Steel Corporation bookings probably bring the November sales in excess of 700,000 tons.

Technical Articles.

"Rolling Refines Grain Structure," by Welton J. Crook, associate professor of metallurgy, Leland Stanford University, Stanford University, Calif., and consulting metallurgical engineer, Pacific Coast Steel Company, San Francisco, gives an account of recent experiments.

"Make Malleable on Pacific Coast." New castings plant recently completed in California is notable for changes from customary practice, one building housing all departments.

"Ventilating Electrical Machinery." Rolling mill motors and auxiliary apparatus are cooled by washed air under pressure. Efficiency and capacity of electrical equipment depend upon operating temperature.

"Mill Combination Increases Yield." Improvement program recently completed at an Ohio steel works and involving the rearrangement of rolling mills, enlargement of the blast furnace and installation of steam generating equipment results in more efficient operation.

"New Demands for Reinforcing Steel." Distribution of Portland cement shows extensive uses in various construction enterprises. Standardized forms employed by some builders.

"Estimating Iron Ore Resources." World's actual supply sufficient for 76 years; potential tonnage to be exhausted by year 2200. A digest of the lecture at Princeton University by Charles Page Perin of Perin & Marshall, New York.

"Show Visualizes Scope of Power." Third exposition of power and mechanical engineering includes exhibits of 375 manufacturers.

"Mining Clean Metallurgical Coal." Cost of steel making increased by high ash coal, manufacturers real-

izing need for a more economical fuel and are taking steps to improve production.

"Today's Power Equal to 30 Slaves for Each Person." For present, efforts should be concentrated on increasing general efficiency of power generation in existing types of equipment. That sources of power will take place of fuel in future generations?

"New Furnaces Serve Forge Presses." Unit recently completed by Chicago forging manufacturer is equipped with five oil-fired, regenerative-type heating furnaces and 1000-ton steam-hydraulic press; finishing department is included.—Iron Trade Review.

Current Articles

"Making Steel Tubes for Roller Bearings." Electric furnace plant for alloy steel; from ingot to seamless tube in a series of mills; piercing mill used.

"Vacation Plans for Wage Workers." Valuable information obtained from many manufacturers in 26 states and Canada; various methods adopted.

"Aluminum and Titanium Deoxidizers." Comparative effect on acid electric steel castings; physical and photomicrographic results.

"Pig Iron Output Higher in November." Net gain of 23 furnaces in blast, with 27 blown in and four shut down; increase of 3,749 tons per day.

"Ferrophosphorus from the Electric Furnace."

"Normal Capacity of Turret Lathe Increased." Offset chuck jaws effect nearly double production; combining operations improves quality of product.

"Diverse Program at Engineers' Meeting." Machine-shop practice and management discussed; research on metal springs to be conducted; oil, gas and steam power.

"Using Briquetted Chips as Furnace Scrap." Compressed material turned out by a machine of 6½ tons capacity per hour; method of gathering the chips.

"Hollow Balls Made from Strips and Tubing." Produced without seams, joints or plugs from single piece of metal; rolling operations follow press work.

"Organization for Better Foundry Practice." One man vs. decentralized control; analysis of the business; successful one-man operation and its limitations.

"Methods Employed in Scrapping Warships."

"Furnace Installation for Heating Nickel." Double chamber oil fired units for heating slabs for rolling and for annealing; automatic control provided.

"Feed Water Heaters Difficult to Machine." Upright drill used for combined boring and counter-boring operation; improvised lapping machine-turret lathe saves foundry cost.

"Car Dumper of Unusual Size and Capacity." Designed for cars carrying 120 net tons of coal; three men handle operation by electric and steam power.

"Causes of Defects in Casting of Complex Design."

"German and French Metallurgical Equipment."

"High-Frequency Inductive Heating."

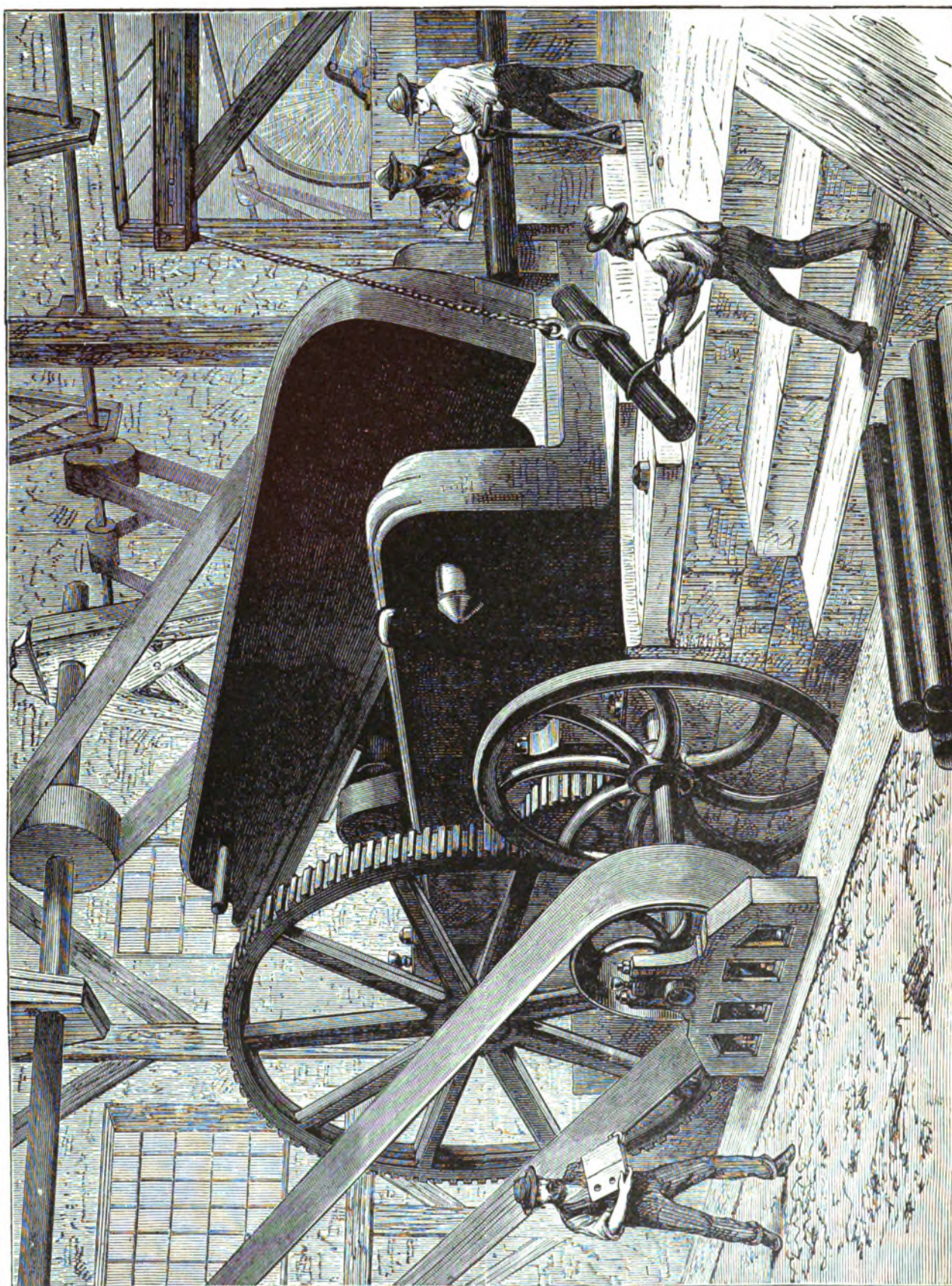
"Fundamentalism in Ferrous Metallurgy."

—Iron Age for December.

[SEPTEMBER 4, 1875.]

FRANK LESLIE'S ILLUSTRATED NEWSPAPER.

448



Mammoth shears. On this page is a correct picture of the mammoth shears, built at the Atlas Ironworks, Pittsburgh, Pa., Chas. S. Hillard, engineer, for the Morsie Iron Company, Montreal. This machine is probably the largest of its kind in the world. The weight of the bed-plate is 40,840 pounds; lever, 19,945 pounds. Whole weight of shears, 50 tons. The lever works on a 9-in. cast steel shaft, forged by Park, Bro. & Co., Black Diamond Steel Works, Pittsburgh. It is the largest steel shaft ever forged by that company; the machine is driven by two 42-in. pulleys, 14-in. face. The leverage is 74 to 1.

The Manufacture of Russian Sheet Iron

An Historical Excerpt from Frank Leslie's Illustrated Newspaper
Dated January 24, 1874

By HOWARD B. COLLINS*

It is well known that Russia enjoys a monopoly of the manufacture of a certain kind of sheet-iron which takes its name from that country. It is remarkable for its smooth, glossy surface, which is dark metallic gray, and not bluish gray, like that of common sheet-iron. On bending it backward and forward with the fingers no scale is separated, as in the case with sheet-iron manufactured in the ordinary way by rolling; but on folding it closely, as though it were paper, and unfolding it, small scales are detached along the line of the fold.

The attention of John Percy, M.D., F.R.S., has been called to the process, and he has succeeded in obtaining descriptions from the leading manufacturers. In a recently published pamphlet the entire work is explained in detail. From the accompanying illustrations it will be an easy study to familiarize this very important manufacture.

The manufacture of sheet-iron in Russia is chiefly confined to the iron-works on the eastern side of the Oural Mountains. The malleable iron, which is the subject of this manufacture, is derived from pig-iron, obtained by smelting the following ores with charcoal in cold-blast furnaces, namely: magnetite, carbonate of iron (sphæro siderite) and red and brown hæmatite. The conversion of the pig-iron into malleable iron is effected either in the charcoal-finery or in the puddling furnace.

The puddle-balls, intended for the manufacture of sheet-iron, are rolled into bars 5 in. wide and $\frac{1}{4}$ in. thick. The iron should be more crystalline than fibrous, and should contain sufficient carbon to render it more like steel than iron. The machinery required consists of one or two pairs of rolls and two kinds of hammers. Reheating is conducted in furnaces of particular construction. The rolls are driven by water-wheels, and should make not fewer than 50 revolutions per minute. The hammers are also put in motion by cams on the axles of water-wheels. The hammer-heads are of wrought-iron, with striking faces of steel. Each anvil consists of a solid block of white cast-iron. It is necessary that the hammers and anvils should be so made in order that they may have the requisite hardness, in default of which the surfaces of the sheets would not acquire sufficient brightness or polish. One kind of hammer is used for widening, and the other for smoothing the sheets; both are raised to the height of 28 inches, and give from 35 to 40 blows a minute.

The reheating furnace is represented in Fig. 1. It will be perceived that this furnace differs widely from the reheating or annealing furnaces employed in this country. The fireplace extends under the bed of the reheating chamber from end to end, and the gaseous products of combustion enter that chamber through a series of five similar and equal openings in the bottom on each side. In the construction of these furnaces there is one principle which must be rigidly observed, namely, the complete exclusion, as far as practicable, of free atmospheric air from the reheating

*New York, N. Y.

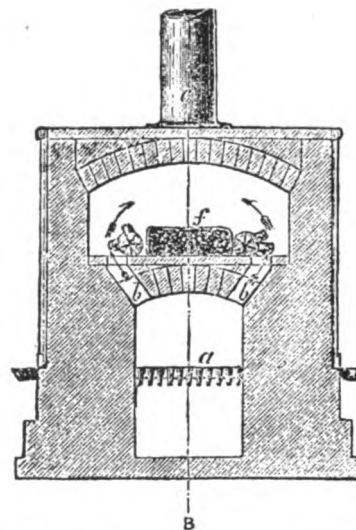


FIG. 1.—FURNACE.

- a. Grate.
- b b b. Flues leading from the fireplace into the reheating chamber.
- c. Chimney made of riveted ironplate.
- f. Packet of sheets, surrounded by logs of wood.

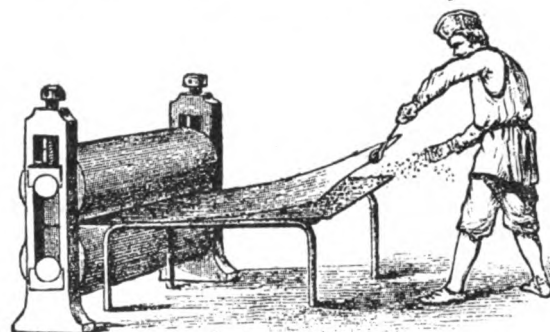


FIG. 2.—MANNER OF STREWING THE CHARCOAL-POWDER BETWEEN THE SHEETS.

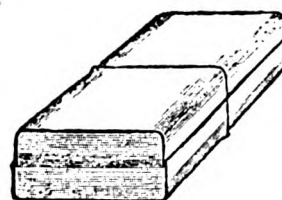


FIG. 3.—PACKET OF SHEETS BOUND UP.



FIG. 4.—PACKET OF SHEETS, SHOWING THE GARDEN IN WHICH THE BLOWS OF THE HAMMER ARE GIVEN.

chamber, in order to prevent superficial oxidation of the sheets. With this view, not only must the walls be made impervious to air, but the fire and ash-pit doors, as well as the end door, must be made to fit as tight as possible.

The puddle-bars, 5 in. wide and $\frac{1}{4}$ in. thick, are cut into pieces 29 in. long, which weigh about 15.35 lbs. avoirdupois. These pieces are heated to redness and cross-rolled into sheets about 29 in. square; and in order to become thus extended, they require to be passed through the rolls about 12 or 14 times. The sheets thus produced are arranged in packets of three in each, heated to redness and rolled, each packet passing through the rolls about 10 times. But just before rolling, the surface of each packet is cleaned with a wet broom, usually made of the green leaves of the silver-fir, and powdered charcoal is strewn between the sheets, in the manner shown in Fig. 2.

The sheets obtained from this rolling are sheared to the dimensions of 28 in. by 56 in. Each sheared sheet is brushed all over with a mixture of birch charcoal-powder and water, and then dried. The sheets, so coated with a thin layer of charcoal-powder, are arranged in packets containing from 70 to 100 sheets each; and each packet is bound up in waste sheets, of which two are placed at the top and two at the bottom, as shown in Fig. 3. A single packet at a time is reheated, with logs of wood about seven feet long placed round it, as represented in Fig. 1, the object of which is to avoid, as far as possible, the presence of free oxygen in the reheating chamber. The gases and vapors evolved from heated wood contain combustible matter which would tend to protect the sheets from oxidation in the event of free oxygen finding its way into the reheating chamber.

The packet is heated slowly during five or six hours, after which it is taken out by means of large tongs and hammered under the first kind of hammer. The packet is moved so that the blows fall in the order indicated in Fig. 4. After this treatment the surface of the packet presents a wavy appearance, as the striking face of the hammer and the face of the anvil are both rather narrow. When the packet has traveled about six times under the hammer, in the manner specified, from a to b (see Fig. 4) it is removed, and immediately afterwards completely finished sheets are arranged alternately between those of the packet. The packet thus composed, which contains from 140 to 200, or twice the number of sheets in the packet subjected to the first hammer, is hammered under the second kind of hammer in the same manner, but not to the same extent, as the first packet. Instead of being moved to and fro six times from right to left, it is moved so only twice. By this treatment, if the hammering be carefully executed, the sheets acquire a perfectly smooth surface; but this result would not be obtained without the interposition of the smooth-faced finished plates in the manner above described. After the second hammering the packet is opened, the surface of each sheet is again cleaned with a wet broom, and the sheets are set separately in a vertical rack, in order to cool. These sheets are next sheared to the dimensions of 28 in. by 56 in.

The actual cost of manufacturing these Russian sheets is about \$60 per ton, to which must be added general charges, which raise the amount to \$80 or \$85 per ton, exclusive of profit. The average price of sheet-iron at the fair of Nijni-Novgorod is about \$110 or \$115 per ton.

Bethlehem's Twentieth Birthday

Every business which attains great success is founded on a big idea. Bethlehem Steel Corporation was founded on the idea of supplying commercial steel to the rapidly growing market in the eastern section of the United States.

That idea has been carried out until today, on our 20th birthday, Bethlehem has a steel capacity over sixty times as great as in 1904 when the Corporation was formed. Bethlehem has acquired new plants and modernized old ones; purchased raw material deposits and transportation lines and integrated its properties so as to produce various lines of steel products in the districts ready to consume such production.

On this 20th birthday of our Company, I want to congratulate the men whose efforts have brought about this progress. Some of us have been with Bethlehem since before the present corporation was formed, while others of us have come in with the development of Bethlehem's activities. Both have played important parts in the development of that spirit which has given "Bethlehem" its present place in industry.

We have reached one turning point in our history, yet I am sure we stand on the threshold of a new progress which will rival that made since 1904. That new progress depends on us. If we give to Bethlehem the best effort and thought, individually and collectively, of which we are capable, the same kind of thought and effort we have given in the past 20 years, there is no doubt about the future growth and prosperity of our business.

E. G. Grace, President.

Twenty Years of Progress.

Twenty years ago, on December 10, 1904, the existing Bethlehem Steel Corporation was incorporated under the laws of the State of New Jersey. At that time Bethlehem was a small producer of a limited number of steel products, employing less than 9,500 men.

About 20 years before the Bethlehem Steel Corporation was incorporated, the old Bethlehem Iron Company had gone into the manufacture of armor plate and other war material at the request of the United States government. The new management decided that there was not sufficient demand for armor plate and war material to insure continued earnings for a company of Bethlehem's size on such work and that the continuation of work along these lines would not be taking advantage of the growing eastern steel market.

Bethlehem Adopts New Business Policy.

Bethlehem's geographical position, at the door step of the great eastern consuming market, provided the opportunity for a great steel company manufacturing a widely diversified line of steel products. To develop this opportunity successfully meant the rebuilding of the entire structure of the corporation and the building, purchasing and remodeling of plants to manufacture commercial steel.

Bethlehem Today.

Today, Bethlehem is the second largest producer of commercial steel in the world with an almost universal line of products.

An ever-growing family of Bethlehem men have carried on the policy around which the Bethlehem Steel Corporation was formed. Bethlehem has added, by acquisition, commercial steel plants of long standing. The Cambria Plant originally The Cambria Iron Company and latterly a part of the Midvale interests had been a leader in the manufacture of iron and steel products since 1852. The Coatesville Plant formerly owned by Midvale had been in operation since 1896. The Lackawanna Plant started operation in 1884. By its acquisition the company was enabled to take advantage of manufacturing and distributing possibilities to a great and growing industrial region throughout the Great Lakes. Acquisition of the Pennsylvania Steel Company brought in the Steelton Plant which commenced operation in 1866, and Maryland Plant, which was started in 1891. In the absorption of the American Iron and Steel Company the Lebanon Plant added to the Corporation's commercial development a complete line of bolts, nuts, rivets and spikes, the manufacture of which had been a specialty dating back to 1882. While the consummation of the commercial development was delayed in some of the plants during the war, Bethlehem has now reached the point where practically its entire operations are devoted to the making of commercial steel products. Slightly more than 1 per cent of the company's property is now devoted to ordnance production or war materials of any kind, and less than 8 per cent of the property is devoted to shipbuilding, while from another standpoint less than 150 of the Corporation's 70,000 employees are working on ordnance or munitions manufacture.

How the Policy of 1904 Has Been Carried Out.

In carrying out the policy of 1924, the development of Bethlehem has been the development of the three fundamentals necessary to a successful steel business (1) conveniently located raw material supplies, (2) plants located and equipped for economical production and distribution, (3) personnel.

1. Development of Raw Material Supply.

When the corporation was formed 20 years ago, Bethlehem owned neither coal mines nor iron ore deposits with the exception of small ore holdings in Cuba; and Bethlehem neither owned nor quarried its own limestone. Today Bethlehem Steel Corporation owns and operates mines supplying its coal, ore and limestone.

These deposits alone are sufficient to maintain operations of present facilities at capacity for more than half a century.

The geographical distribution of these deposits is such as to make them available at low transportation costs to each of Bethlehem's seven steel making plants. Bethlehem is further protected against the future and helped in maintaining low operating costs by owning and operating in large part the transportation facilities on rail, lake and ocean, needed to bring these raw materials to the blast furnaces. In 1904 Bethlehem owned 12 locomotives, today there are over 150 locomotives in operation over 450 miles of company owned tracks, as well as 23 ships in ocean and lake transportation.

2. Growth of Plants.

In 1904 Bethlehem's entire ingot capacity, all of which was in one plant, amounted to 120,000 tons a year. The other units of the corporation were shipbuilding yards, foundries and machine shops.

Today, Bethlehem's ingot capacity amounts to 7,600,000 tons distributed among seven steel plants with good business locations.

The mere increase in physical capacity, however, does not tell the full story of Bethlehem's growth. There has been a corresponding increase in efficiency of operation due to the adoption of modern methods and the advantages resulting from specialized manufacture.

3. Development of Personnel.

Consolidation has offered many opportunities for economies in organization. The plans for human relations and methods of management which had been found to operate successfully to the advantage of both employees and the company, have been introduced in all properties. Plans for accident prevention, pensions, sickness relief, adequate housing, employee representation and saving and stock ownership have been developed.

The supervision and personnel in each plant has been organized along similar lines allowing for the inter-change of manufacturing practices and comparison of results. Further savings and improved results have come as a result of the consolidation of the accounting, shipping, order, production and other departments.

As a result of Bethlehem's plan of distributing work, the men in the various plants become trained to produce specialized products with resulting improvements in quality, cost and production.

Through this plan, Bethlehem is enabled to retain in a large organization, the advantages of personal contact, usually found only in comparatively small organizations.

New Construction.

Immediately following the formation of the Corporation in 1904, building, purchasing and remodeling of plants for the manufacture of commercial steel products started. The first of these units being the new steel rail and structural mills which was completed in 1907 and Bethlehem has been building constantly ever since.

An important part of the growth in capacity has been the modernizing of the purchased properties in accordance with the advance of science and the art of steel making. It was necessary for Bethlehem to put considerable money into the modernizing of the plants which were purchased. Thus Bethlehem bought an opportunity to build modern plants in advantageous places as well as to acquire existing machinery and properties with an established business.

Reinvestment of Profits.

While much of Bethlehem's growth has been paid for out of profits, new properties have been acquired largely through the issue of bonds and stock. The following table shows how profits have been put back into the properties each year to bring about the position enjoyed on this 20th birthday. This illustrates the gradual but steady increase in the total value of the properties which in turn provides greater indi-

vidual opportunities in the building of a greater business.

Year	Cash expenditures for additions and improvements	Net Value of Properties to date
1905	\$ 4,325,257.61	\$ 31,520,592.47
1906	6,039,917.55	37,382,920.93
1907	6,743,620.08	43,886,795.10
1908	1,651,507.46	45,594,266.87
1909	634,349.24	48,015,016.78
1910	5,359,917.17	52,797,040.48
1911	2,435,388.60	54,221,033.84
1912	2,512,126.76	56,403,977.69
1913	5,774,146.86	62,915,616.06
1914	8,530,631.77	69,331,117.87
1915	13,333,445.20	76,955,705.24
1916	28,216,020.59	131,983,860.02
1917	62,168,948.51	187,242,505.86
1918	28,904,496.96	182,598,786.71
1919	26,919,746.96	205,212,149.71
1920	34,054,397.39	231,662,900.60
1921	11,269,702.54	238,285,994.70
1922	10,798,878.02	304,205,071.14
1923	19,914,660.36	452,936,911.24
Total	\$279,587,159.63	

Dividing Work Among the Plants.

It has been the policy of Bethlehem's management in acquiring new plants to divide and sub-divide work so that each plant will make special steel products selected in accordance with the layout of the plant, the

supply of raw materials and the market for the products. In addition to the manufacture of coke and its by-products, pig iron, ingots, blooms, billets, slabs, bars, bands and many other products, the manufacture of which is general in most steel plants, the division of other products upon which the plants particularly specialize is somewhat as follows:

Bethlehem Plant.

Bethlehem special and standard shapes, alloy and special steels, tool steels for every purpose, drop, hammered and pressed forgings, castings of all kinds, ingot moulds, hydraulic and special machinery, gas and Diesel oil engines, structural steel fabrication, rolled steel truck wheels.

Steelton Plant.

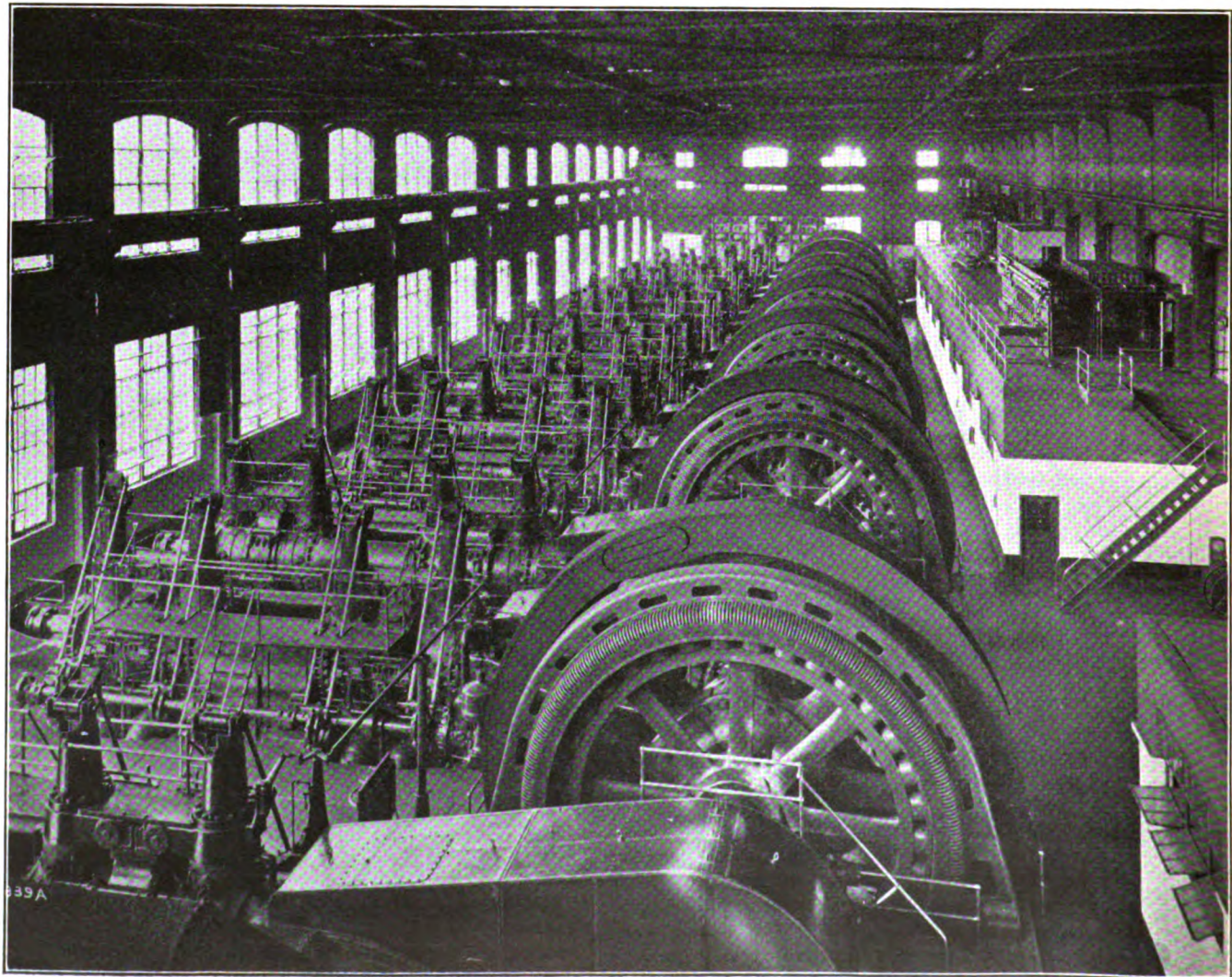
Rails, frogs and switches, special track work, fabrication of bridges, buildings and other steel structures. Railroad turntables.

Lebanon Plant.

Bolts, nuts, rivets, spikes, turnbuckles, tierods, pole line material.

Maryland Plant.

Rails, steel plates, sheet bar, sheet steel and tin plate.



These huge gas-engines built by Bethlehem form a main power house at Bethlehem Steel.

Lackawanna Plant

Rails, steel plates, bars and structural shapes, fabrication of steel structures, sheet steel piling.

Cambria Plant

Steel freight cars, wheels and axles, wire and wire products, rolled steel blanks for gears, flywheels and other circular forgings, sheet bars and small steel shapes for every purpose, steel mine ties, steel plates.

Coatesville Plant.

Steel plates, boiler heads and miscellaneous pressed work, boiler tubes.

Detrick & Harvey Plant.

Planers, drilling, boring and milling machines, and other machine tools.

In the shipyards the same principle has been carried out. The plants are equipped to build, repair and convert all types of vessels. Other important activities at the shipyards include the building of steel passenger cars, oil field equipment, power plant equipment and marine auxiliary machinery.

Capacity Increased 60 Times—8 Times as Many Employees.

Coincident with changing from ordnance to commercial steel manufacture, and as a result of the careful arrangement of work in every Bethlehem plant, today the corporation has an ingot capacity 60 times greater than it had in 1904, with only 8 times as many employees.

On its 20th birthday Bethlehem has approached the completion of the plans of 1904 for the establishment of a great commercial steel business in the eastern section of the United States.

A Book Review

By Prof. W. Trinks

"Heat Economy of Power Plants and Combustion Equipment in Industry, with Particular Reference to the Iron, Paper, and Chemical Industries," by Wilhelm Tafel, Professor at the Polytechnicum in Breslau, Germany. 349 pages, 5x9, with 125 illustrations, and two tables.

The never ending increase of technical applications of physics and chemistry leaves very little time for the teacher in engineering to discuss those fundamentals which are common to different lines of engineering. Professor Tafel, who teaches what might be called the mechanical engineering of the chemical industries, found himself in the before mentioned position and decided to write a text which would show the application of heat and combustion engineering to the various branches of engineering, and more particularly to steel works engineering and chemical engineering. The text, which was recently published by R. Oldenbourg in Munchen in Berlin and which is obtainable through G. E. Stechert & Company, 31 East Tenth Street, New York City, has the following contents: The principles of thermodynamics as foundation of heat economy. Diesel engines and gas engines. Steam engines and steam turbines, including boilers, superheaters, and steam regenerators. Then follow the principles of combustion, including regeneration and recuperation of combustion air and the movement of gases in furnaces. The next chapter takes up the losses on combustion of fuels and efficiency of combustion, and is followed by construction and operation of various combustion devices and furnaces. There are also two very short chapters on heating of fac-

tories and on measurements in connection with combustion devices. The third part contains applications to special industries, more particularly to the iron and steel industry. The heat economy of the blast furnace is discussed in detail, while the heat economy of the converter, of the open hearth, and of the electric furnace are given somewhat more briefly. The application of heat economy to the rolling mill and to the rolling mill furnace are investigated in some detail. The chapter on the chemical industries deals particularly with steam for heating and power generation, with losses in steam pipes, with bleeder turbines, and engines, injectors, pulsometers, and heat transfer in cooking and evaporation equipment. A very brief chapter deals with paper manufacture.

Those who can read German will enjoy the book, because it gives a birds eye view of heat economy in the various industries. Those who specialize in heat economy and in combustion engineering will perhaps find fault with the rather general treatment which Professor Tafel gives the subject, but the detailed treatment which the specialist is looking for can be given in a textbook. The book is destined and intended particularly for students of chemical and metallurgical engineering, and does indeed fill the bill of giving them that fundamental knowledge of the application of heat which they need later on in their daily work, with the understanding that additional and more detailed knowledge must be gained later on by actual experience or by reading of trade papers and scientific publications.

The very praiseworthy effort of Professor Tafel will doubtless be appreciated much more in Germany than in the United States, not only because of the difficulty which most American engineers have in reading German, but also on account of the fact that fuel economy is very much more important in Germany than it is in the United States. In Germany, fuel is expensive and labor is cheap, whereas in most parts of the United States fuel is comparatively cheap and labor is dear. Nevertheless, fuel is becoming more expensive right along, even in the United States, and some day we who live in the United States will be compelled to husband our fuel resources just as much as the Germans are compelled to do at the present time. From that standpoint, it will pay to read Professor Tafel's book because it indicates a trend of development which even the United States will have to undergo sooner or later.

The Kansas City Bolt & Nut Company, Kansas City, Mo., has work under way on an addition to its rolling mill department, to be equipped as a jobbing mill. The installation will consist of an 84-in. two-stand mill, with tables, shears, roller leveler and auxiliary equipment. The machinery will be electrically-operated, using a 1500-hp. motor. A 30-ton electric traveling crane will be installed, as well as other miscellaneous equipment for handling production. Orders for the machinery have been placed.

The Wickwire-Spencer Steel Corporation, Buffalo, N. Y., has completed plans and will begin the construction of a new addition to its plant, 50 by 112 ft., to be equipped as an annealing mill. It will replace a structure destroyed by fire a number of weeks ago. It is expected to install machinery at the earliest possible date, as the structure is said to be badly needed at the works.

Electro-Metallurgical Applications

Conclusion of This Interesting Study, with an Excellent Bibliography of the Sources

By J. L. McK. YARDLEY*

PART II

FIGURES 2 and 3 show the type of step induction regulator transformer unit, which has been largely employed in the economic electric smelting of zinc. It is also the preferable type of unit for use in the economic electric smelting of pig iron. About 22 or more of these units have been installed, and a considerable number, 10 or so, of smaller units of 550 kva, capacity of a similar type. This type of control, as developed particularly for electric smelting, is shown in the diagrams, Figs. 4, 5 and 6, for the different electrical conditions usually met with in practice. The details of this are instructive, particularly to mechanical and electrical engineers. Fig. 7 is a plan or layout of the first complete commercial electric steel

Fig. 8 is a cross sectional view of the smelting furnace showing particularly details of gas recirculating system and giving a good idea of the two parts of the furnace, the shaft in which the reduction of the ore takes place and the crucible in which the pig iron is formed at high temperature. Fig. 9 shows the layout of electrical connections between the regulator transformer and smelting furnace electrodes. Provision is made by mounting the regulator transformer units on trucks traveling on tracks so that the electrical equipment can be shifted quickly from one smelting furnace to the other.

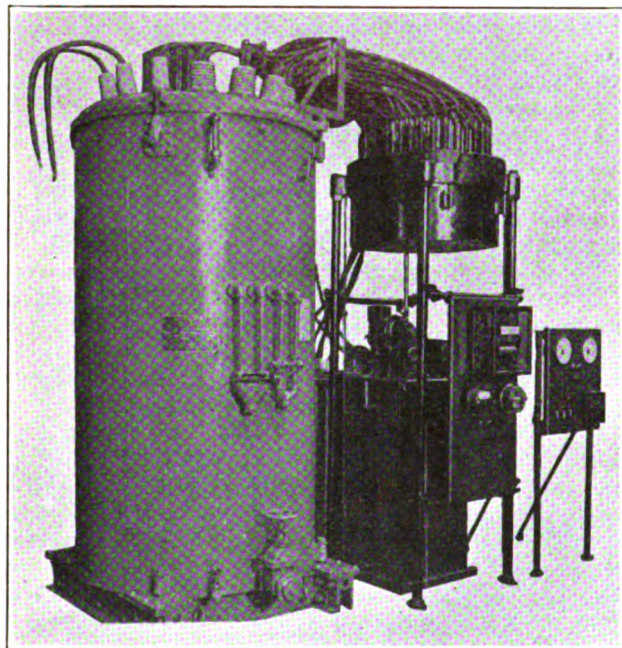


FIG. 2.—1100 kva. step induction regulator transformer equipment for electric smelting furnace. This view shows control panel containing feeder type constant current automatic control.

smelter and rolling mill established in the Western Hemisphere. This is the plant of the Compañía Electro Metallúrgica Brazileira, with a capacity of 30 tons of steel per 24 hours. The equipment consists of—

	KVA.
Two shaft type furnaces (one as standby), voltage range 60 to 120 — each.....	3,000
Two 6-ton Bessemer converters (blowing engine for 1)	700
One 6-ton Ludlum electric steel refining furnace	1,500
One 16-inch rolling mill.....	500
One 10-inch rolling mill.....	500
Miscellaneous 220 volt power for motors, cranes, shops and lighting.....	400
Total installation	6,600

*General Engineer, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

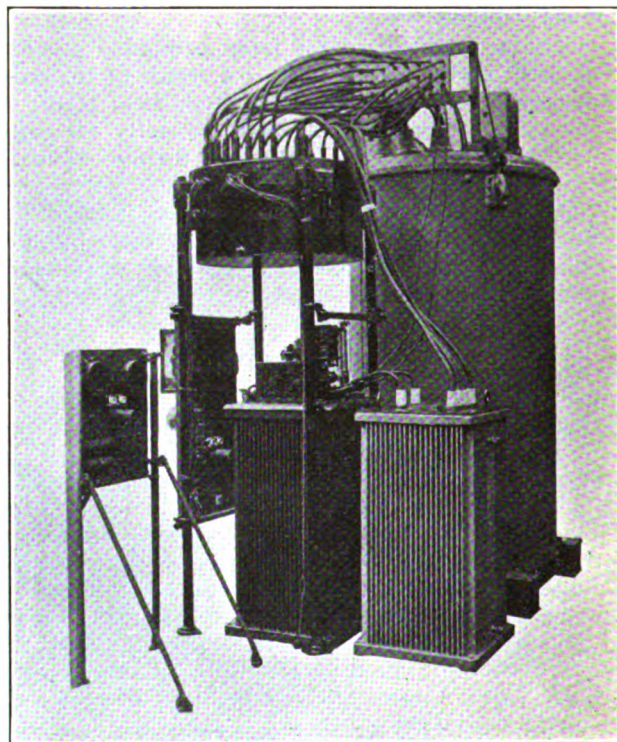
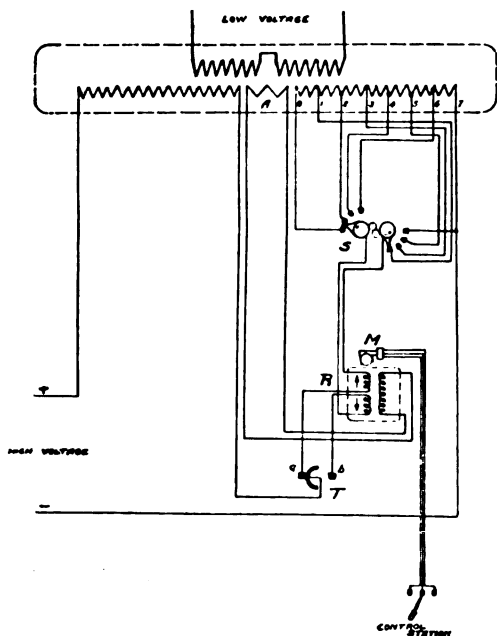
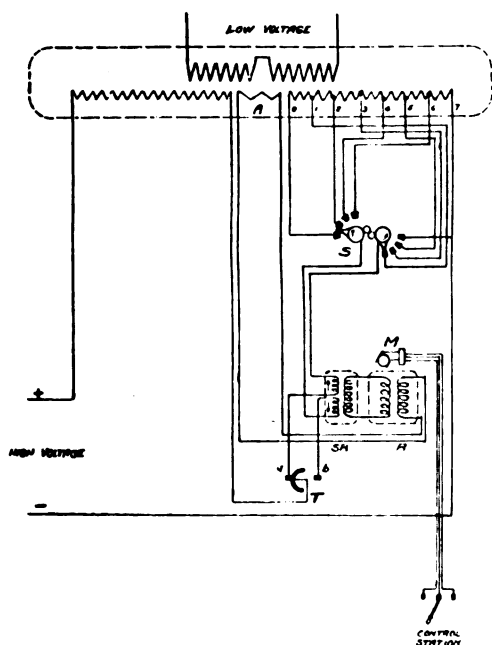
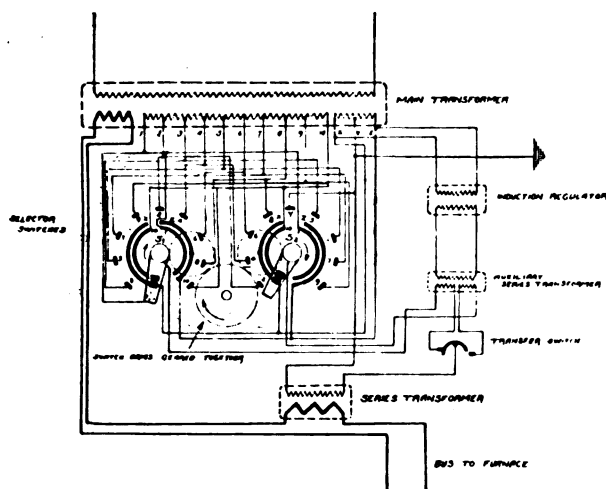


FIG. 3.—View of 1100 kva. step induction regulator transformer equipment for electric smelting furnace which shows particularly the small induction regulator series transformer, tank containing selector switches and rear of control panels.

In Norway also, we have had the electric smelting of copper in large scale tests at an expenditure of 700 kwh. per long ton of charge containing 6 per cent or 132 lbs. of metal and producing a 30 per cent to 40 per cent copper matte. In other words, it has practically been merely a concentrating operation at an expenditure of 5.3 kwh. per lb. of copper contained in the matte. It has been calculated that the concentrates from one of our western mines containing about 32 per cent Cu could be smelted by electricity, producing a matte of from 53 per cent to 68 per cent Cu at an expenditure of approximately 1 kwh. per lb. of Cu contained. This product would, of course, still require additional expensive treatment. By the electrolytic



process, 700 kwh. will produce 700 lbs., or 1 lb. per kwh. of high grade copper, requiring very little further treatment to be in merchantable form; and this is produced from a solution or electrolyte containing only a few per cent of Cu obtained by the action of dilute H_2SO_4 upon raw low grade oxidized ore containing only around $1\frac{1}{2}$ per cent Cu. The electrolyte may, of course, also be obtained by the action of H_2SO_4 upon concentrates of sulphide ores which have been oxidized by roasting.

Turning to the electrolytic processes, voltage, rather than temperature (at least usually) induces dissociation and, owing to the low temperature at which these processes (usually) may be conducted, efficiency as has been stated is not a function of the quantity of charge that is, the quantity of material in course of treatment, but is a function of the amount of metal deposited. In view of the growth and future prospects of electrolytic processes in the production of metals commonly used in construction and manufacture, mechanical and electrical engineers must take more than a detached or theoretical interest in the subject. The

FIG. 4.—Diagram of step induction regulator transformer unit for electric smelting furnace. This diagram shows the scheme so clearly that, taken together with descriptions with Figs. 5 and 6, further detail description is unnecessary. When the primary supply voltage is very high it is desirable to have a separate winding on the transformer of moderate voltage upon which the auxiliary control apparatus will operate. By this means, it will be obvious that the electrical apparatus such as selector switches, induction regulator, etc., will be of comparatively small capacity.

FIG. 5.—Diagram of step induction regulator transformer unit for electric smelting furnace. The transformer has three windings, the first a low voltage winding connected to the furnace, the second a comparatively low voltage winding marked "A" for excitation of the induction regulator and the third the high voltage primary winding divided into two sections. The section to the right is divided into many parts and taps are brought out for connection to the selector switch. By this means, various parts of this section may be cut out or in by the operation of the switch "S", as it is desired to raise or lower the furnace voltage. The series transformer "SR" merely serves to insulate the induction regulator "R" from the incoming primary voltage and the action is the same as though the secondary of the regulator were connected directly to the line. This scheme of connections is satisfactory for moderate primary voltages.

FIG. 6.—Simple diagram of step induction regulator transformer unit for electric smelting furnace. This is used when the primary voltage supply to the furnace unit is comparatively low so that it is unnecessary for the sake of economy to insulate either the induction regulator or the selector switches. The "buck" or "boost" of the induction regulator is equal to one-half the voltage existing between adjacent transformer taps. When it is desired to vary the furnace voltage, it is merely necessary to start the operating motor "M" of the regulator and if the regulator has been in neutral position, immediately a voltage is induced in the secondary of the regulator. In raising furnace voltage, this induced voltage would add to the supply voltage. With the regulator continuing to revolve the induced voltage reaches its maximum which is one-half the voltage between adjacent transformer taps. At this point, the selector switch "S" being geared to the regulator, operates so that the induced voltage in the regulator subtracts from rather than adds to the supply voltage. This last operation is secured by having the secondary of the regulator made up of two windings, so that the reversal from boost to buck can be made through the transfer switch by reversing one of these windings. This feature allows the induction regulator to be rotated continuously in one direction for either raising or lowering the furnace voltage. It is obvious that this equipment may be controlled entirely automatically by a constant current regulator or a constant energy regulator.

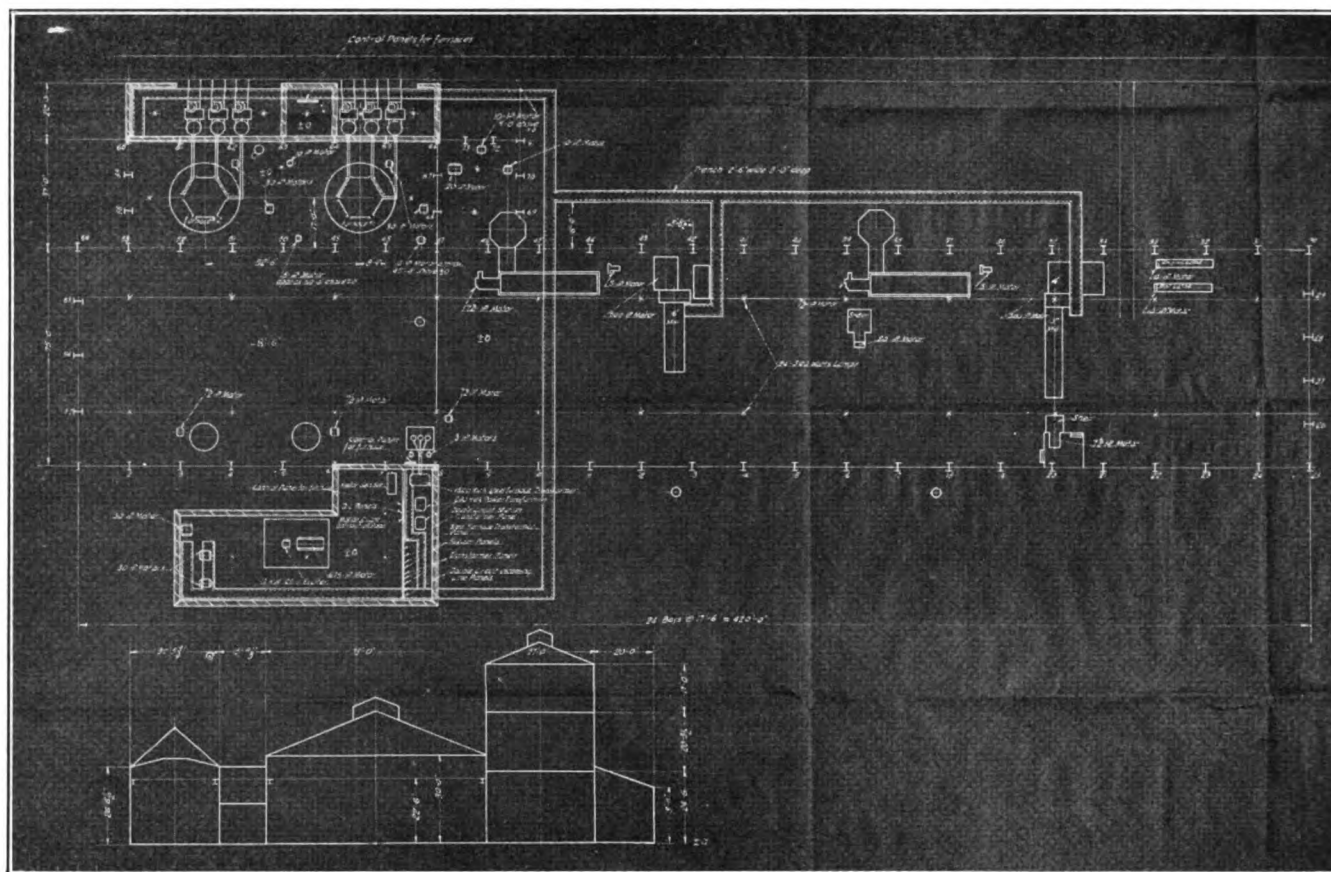


FIG. 7.—Electric Steel smelter and rolling mill—Compania Electro Metallurgica Brasileira—30 tons capacity per 24 hours.

table, Fig. 10*, shows considerable data with relation to the status of electrolysis as applied to the production of metals at the present time, particularly in the Western Hemisphere. Where not obtained from published sources, this data is only approximate, but a study of it will indicate the correctness of many of the statements made.

The chart, Fig. 10, shows how the problem in the metallurgical plant passes from the physical and chemical to the electrochemical and electrometallurgical and on to the purely electrical. Perhaps of all the columns, the mechanical or electrical engineer is most interested in one near the center showing the overall efficiency of the electrochemical process and one to the right showing the efficiency of the purely electrical part of the installation. It is assumed that power is delivered at the electrochemical substation from the company's own power plant, or purchased from an external power plant in the form of a.c.; and the electrical efficiency given represents the efficiency of the electrical circuit from that point to the busses on top of the cells upon which the anodes and cathodes rest. The particularly interesting point is that in the relatively modern and efficient installation from 7.5 per cent to 15 per cent of the power received at the electrolytic substation is lost before the current reaches the cells and that the cells themselves in a commercial economic plant are, in general, no more than 50 per cent efficient, that is, they use 100 per cent, or more, more power per lb. of metal produced than would be calculated by the theoretical Faraday and Gibbs-Helmholtz laws. This is well known to those chemists and

metallurgists who are closely associated with this field of engineering, but it is being mentioned because it is not so familiar to mechanical and electrical engineers. It may be said that the present day solution of the electrochemical problem gives an efficiency in the neighborhood of only 50 per cent of the theoretically possible, or rather impossible.

As the electrical problem was rather fully covered in my paper before the American Electrochemical Society, "The Substation Problem of the Electrochemical Plant," Volume 32 of Transactions, and in my discussion before the American Institute of Mining and Metallurgical Engineers, September 1918, on "Electrolytic Zinc", further consideration at this time will be confined especially to features directly affecting efficiency.

Certain conclusions seem to have been borne out by accumulated experience. In general, it is not necessary or advisable to have great voltage range in the electrical supply apparatus. Great voltage range introduces costs and inefficiencies in the electrical equipment which offset advantages gained in the cell room. The most economic all around installation is one in which the cell or tank room layout is designed with sufficient flexibility to demand comparatively small flexibility or voltage range in the electrical apparatus. Except that for all service of 125 volts d.c. and lower the motor generator set is the better application, the table, Fig. 10, shows that the electrical efficiency is much greater for the higher voltage tank rooms (greater for 500 v. than 250 or 125 v. and greater for 250 v. than 125 v.) and when synchronous converters are employed rather than motor generator sets. Synchronous booster converters with about a 12 per cent voltage range seem adequate, that is, say from 220 to 280

*Owing to the impossibility of reproducing Fig. 10, these tables will be supplied separately upon written request.

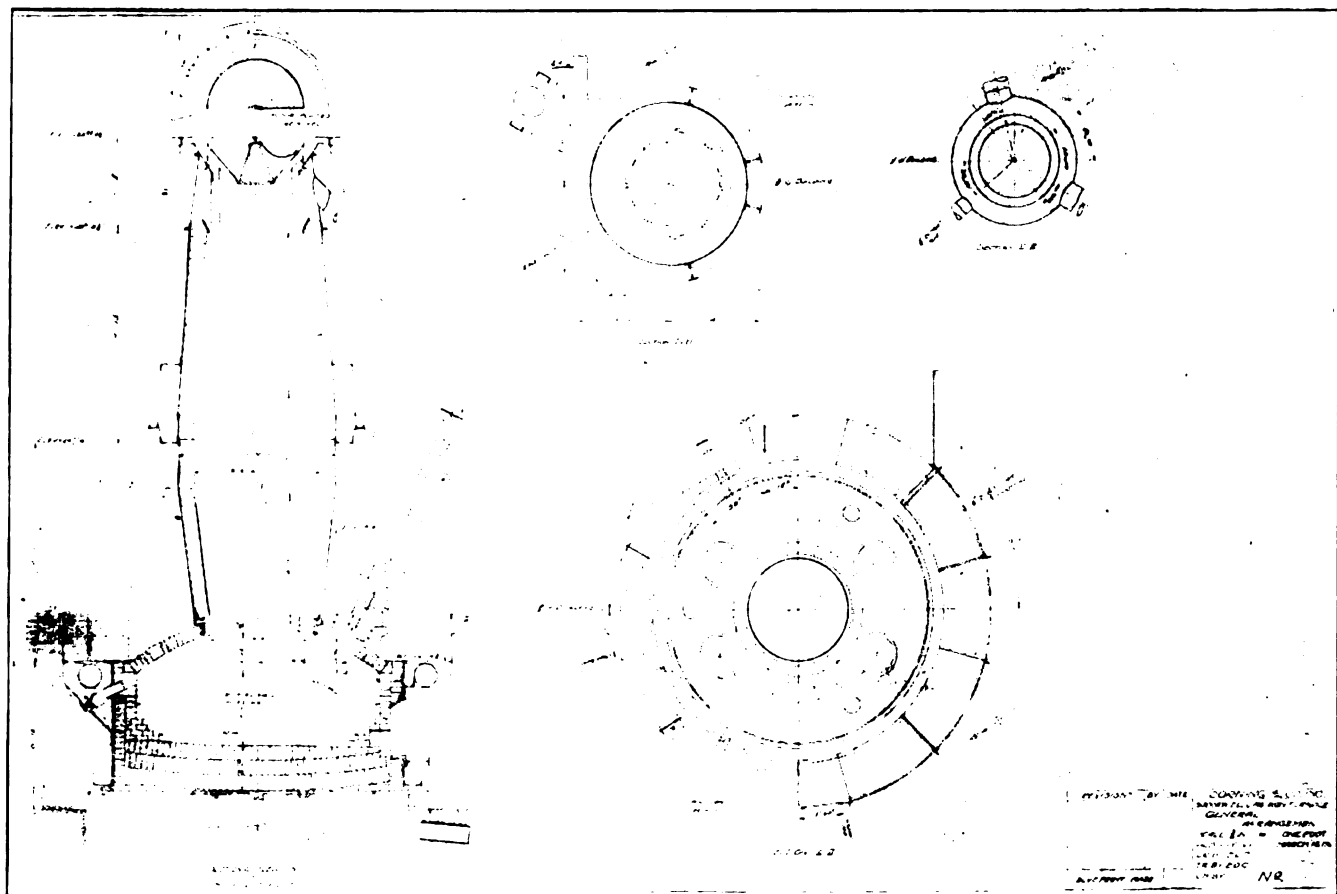


FIG. 8.—Cross section of 3000 kva. electric smelting furnace for pig iron—Compana Electro Metallurgica Brasileira.

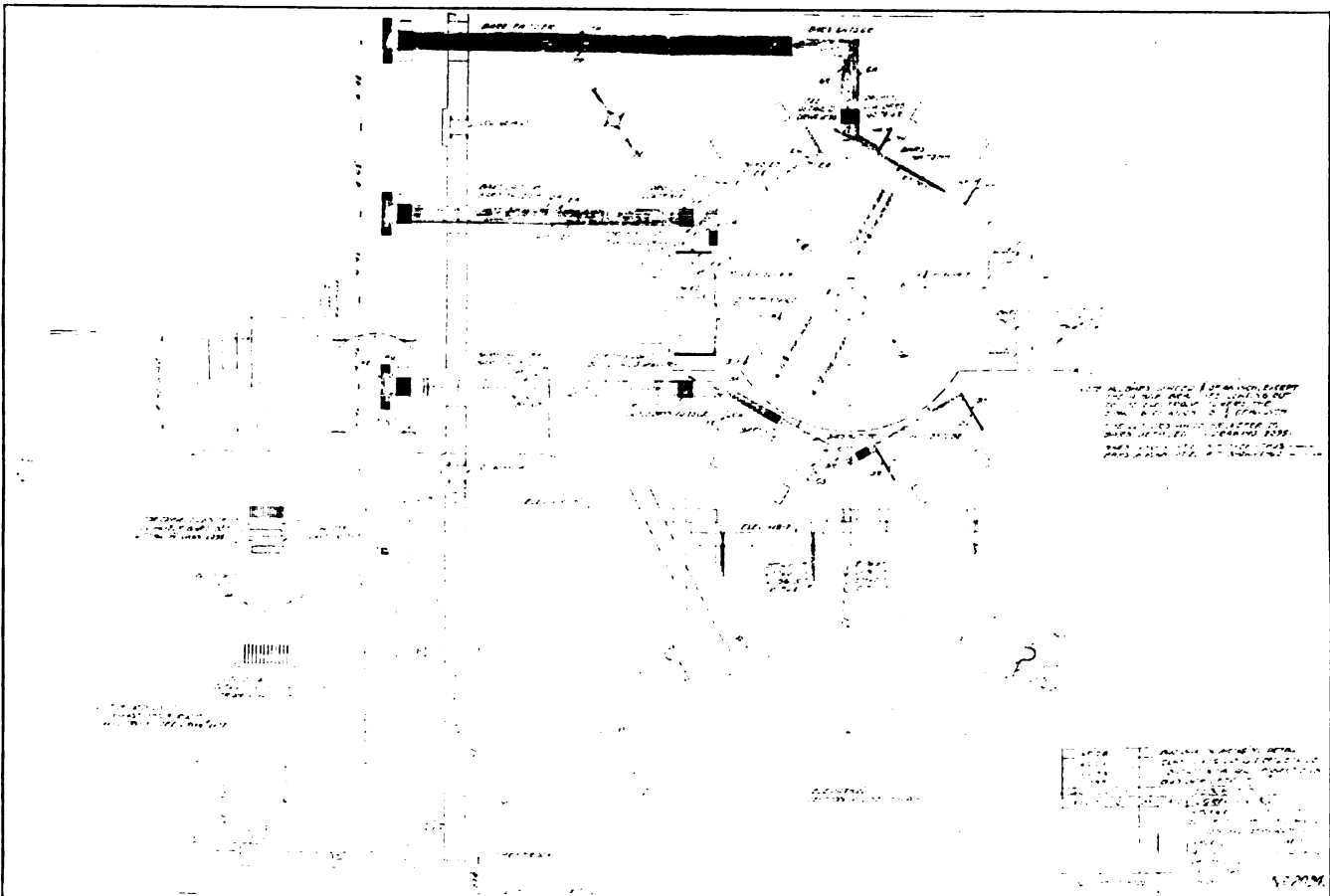


FIG. 9.—Electrical layout, 3000 kva. electric smelting furnace showing connections between transformers and electrode holders—Compana Electro Metallurgica Brasileira.

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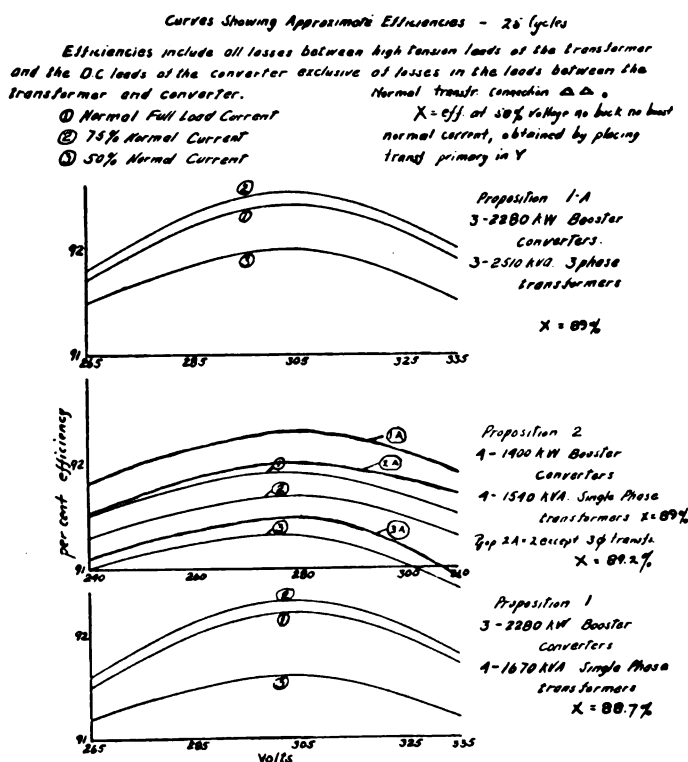


FIG. 11.—Curves showing approximate efficiencies of electrolytic units consisting of synchronous booster converters and transformers. Curves show efficiency from one-half to full load.

v., or from 240 to 300 v., or from 485 to 615 v. In fact, in the aluminum and zinc industries which operate cells at 500 volts and higher, the cells are so manipulated as to require very little voltage variation from the electrical equipment. A large part of the production of aluminum is accomplished by means of straight synchronous converters without boosters.

Fortunately, the synchronous booster converter is an economical machine to build and an efficient one to operate over the range which has been indicated. Some time ago I made an analysis to determine the best electrical plant for an electrolytic copper reduction works, the data of which are typical and illustrative as well as anything could be, that the voltage should be as high as practicable and that unless external conditions, due to transmitted power, are too unfavorable, synchronous booster converters or straight synchronous converters should be used in preference to motor generator sets. This analysis was made because it was known from data such as given in Fig. 10, that some modern commercial plants have 100 per cent higher efficiency in the purely electrical part of the plant than do others. The curves in Figs. 11 and 12 show the efficiencies of a number of electrolytic units, that is, actual combinations of equipment, transformer and synchronous converters, which might be employed. While the service is a constant current service at practically full load, it is noteworthy that high efficiency is obtainable over a considerable range of load and over the entire range of voltage. Indications were that for an electrolytic copper reduction works treating 5,000 tons of ore or more per day, the necessary electrical substation equipment would cost in the neighborhood of \$22 per kw. of continuous supply to the tank room and \$20 per ton of ore treated; and that the cost of the electrical substation, building and

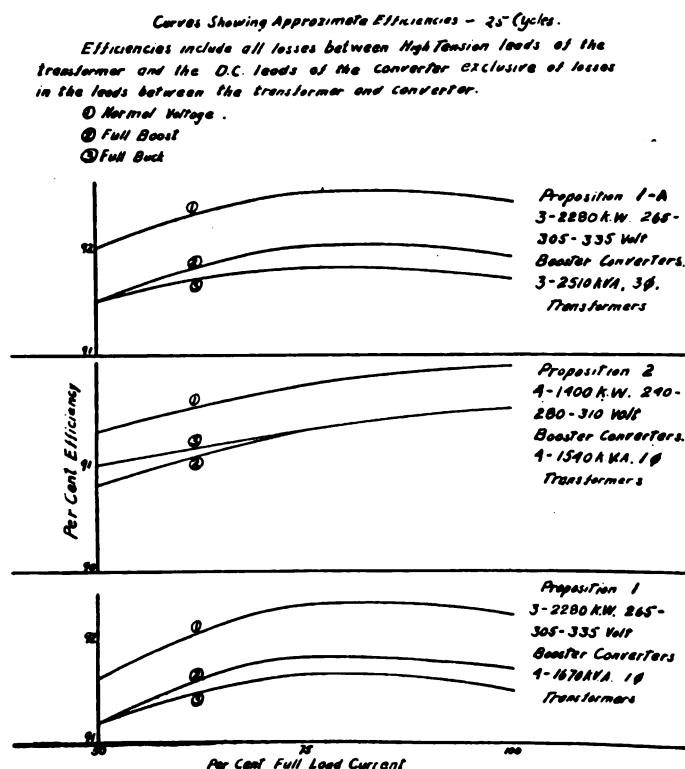


FIG. 12.—Curves showing approximate efficiencies of electrolytic units consisting of synchronous booster converters and transformers. These curves show efficiencies from minimum voltage to maximum voltage of range.

equipment, would be from 15 per cent to 20 per cent of the cost of the tank house. (At this point it is of interest to mention that the ratio of cost of electrical substation to tank house for electrolytic zinc would be higher than this owing to the larger kwh. per pound taken by zinc and the greater current densities employed as shown by chart, Fig. 10.) A tabulation of the equipment considered in this analysis is shown in Fig. 13. This shows first cost very much in favor of higher voltage; and, considering the matter of efficiency of conversion once more, let us assume that the electrolytic copper plant has an output of 60,000,000 lbs. of copper per year at a cost of 10c per lb. Then, the difference in conversion of between 86 per cent and 91 per cent, that is, 5 per cent, will mean something in the neighborhood of .8 per cent of the total production cost of the copper with power at $1\frac{1}{2}$ c per kwh., or more than \$45,000 per year, which is about one-third of the cost of the electrical substation equipment.

It would be impossible to cover the relationship of the mechanical and electrical engineer to the commercial development of economic electrometallurgical processes within the reasonable scope of a technical article. It is desired merely to indicate their close co-relationship with the chemist and metallurgist in working out these problems. It is hoped this survey of the field will be stimulating. Discussion has purposely been confined to the more common metals. Consideration of the electrolytic treatment of precious metals has been purposely omitted, since the quantity of power involved is small. No reference has been made to the electric smelting of metals such as chromium, tungsten, molybdenum, etc., which are used in the production of alloyed steel, nor to the production by smelting or electrolysis of non-metallic materials.

Figure 13.

Electrolytic Substation Equipment for Electrolytic Copper Reduction Works. 5000 tons of ore per day treated producing 100,000 lbs. of copper with 1 KWH. per lb.												
						TRANSFORMERS				Spare		
25 cycles	Plan No.	Conv. No.	KW. each	Voltage Range	Ampere Each	Total KW. Norm. Volt.	No.	Phase	KVA. Each	KVA. Total	Conv. Capcy.	Transf. Eff. %
1	1	3	2280	265-335	7500	6840	4	1	1670	6680	2280	92.3
1-A	3	3	2280	265-335	7500	6840	3	3	2510	7530	2280	92.4
2	4	4	1400	240-310	5000	5600	4	1	1540	6160	1400	91.9
2-A	4	4	1400	240-310	5000	5600	4	3	1540	6160	1400	92.3
3	8	8	650	110-150	5000	5200	8	3	715	7520	680	88.3
4	6	6	950	94-126	8600	5700	6	3	1050	6300	950	88.3
5	2	2	4050	250-290	15000	8100	4	1	1490	5960	4050	91.7
60 cycles - M.G. sets											M.G. set	
2-B	4	4	1500	200-300	6000	6000	-	-	--	--	1500	88.5 - 13200 V.
6	4	4	1700	125-190	10000	6800	-	-	--	--	1700	87.5 - 2300 V.
Booster	Conv. 7	5	1076	122-165	7500	5380	3	3	1200	6000	1076	89.5

Continuous Capacity KW. Max. Boost.	Cost-Conv. and Transf., or M.G. sets, plus Switching Equipment	Daily tonnage can treat	Per ton	Per KW. **	
5000	\$106,930. Approx.	5480	\$19.50	\$21.40	
5000	104,700.	5480	19.10	20.90	
4650	98,610.	5100	19.30	21.20	
4650	99,800.	5100	19.60	21.60	
5250	189,400.	5760	32.90	36.10	
5450	206,950.	5960	34.70	38.00	
4350	128,100.	4760	27.00	29.40	
5400	135,000.	5920	22.80	25.00	
5700	150,000.	6250	24.00	26.30	
4950	130,000.	5430	24.00	26.30	

* Based on 5000 tons per 24 hours requiring approx 4560 KW. DC capacity.

**Based on normal capacity at max. boost. voltage including cost for spare equipment.

The cost figures above are relative merely in an approximate way and should not be interpreted as indicative of present day prices.

Partial List of References.

"The Electrolytic Tank House, Chile Exploration Company, Chuquicamata, Chile", American Electrochemical Society, April, 1924—C. W. Eichrodt.

"Electrodeposition of Copper by the Union Miniere Du Haut Katanga", American Electrochemical Society, April, 1924 — M. Y. Eagle.

"The Deduction and Refining of Tin in the United States", American Institute of Mining and Metallurgical Engineers, March, 1924 — H. H. Alexander and J. R. Stack.

"Green awalt Electrolytic Copper Extraction Process", American Institute of Mining and Metallurgical Engineers, January, 1924 — W. E. Greenawalt.

"Improvement in Electrolytic Refining During the Past Decade", American Electrochemical Society, April, 1924 — S. Skowronski.

"Electrolytic Refining of Tin", American Electrochemical Society, April 1924 — J. R. Stack.

"Direct Electrolysis of Black-Copper Anodes of High Nickel-Lead Content", American Institute of Mining and Metallurgical Engineers, February, 1924 — M. H. Merriss.

"Electrolytic Zinc from Complex Ores," American Institute of Mining and Metallurgical Engineers, February, 1924 — U. C. Tainton and L. T. Leyson.

"The Electrolytic Zinc Plant of the Consolidated Mining and Smelting Company of Canada, Limited",

Chemical and Metallurgical Engineering, August 11, 1920 — L. W. Chapman.

"Electrolytic Zinc Plant of Anaconda Copper Mining and Metallurgical Engineers, Volume 64 — Frederick Daist, F. F. Frick, J. O. Elton, and R. B. Caples.

"First Year of Leaching by the New Cornelia Copper Company", American Institute of Mining and Metallurgical Engineers," Volume 60 — Henry A. Tobelmann and James A. Potter.

"Some Applications of Electrical Enquipment in the Metallurgy of Nickel," Engineering and Mining Journal Press, November 4, 1922—J. L. Mack. Yardley.

"The Substation Problem of the Electrochemical Plant," American Electrochemical Society, Volume 32 —J. L. Mack. Yardley.

Discussion on "Electrolytic Zinc", American Institute of Mining and Metallurgical Engineers, September, 1918—J. L. Mck. Yardley.

"The Electric Furnace for Iron and Steel"—Alfred Stansfield.

"Copper Refining"—Lawrence Addicks.

"The Electric Furnace"—J. N. Pring.

"Electric Smelting of Pig Iron at Domnarfvet, Sweden", Chemical and Metallurgical Engineering, March 9, 1921—Baron Gerard De Geer.

"The Westley Electric Furnace for Copper Smelting", Engineering and Mining Journal Press, March 4, 1922—Sulitjelma Copper Company, Norway.

(Continued on page 30)

SHEET AND TIN PLATE

Chromium—Its Uses and Its Alloys

The effect of chromium in steel is progressive—Nickel chromium steels possess decided advantages for carburizing and case hardening purposes.

By DR. WALTER M. MITCHELL*

PART IV.

It is generally agreed by all investigators that the effect of chromium in steel is progressive, and that there are no areas of composition the boundaries of which indicate abrupt changes in physical properties owing to transition from structurally free solid solution to free carbides, or to free carbides of a different composition. However, the general character of the commercial usefulness of the chromium steels alters with the chromium content, and they may be divided into several classes because of their differently useful properties.

Low Chromium Steels.

In the low chromium, or pearlitic steels, those containing up to 2 or 3 per cent chromium, the effect of this element is to retard grain growth, giving rise to a finer grain structure which increases strength and hardness without loss of toughness or ductility, the steels having the peculiar "tough hardness" characteristic of chromium. With high carbon, 1 to 1.5 per cent, the presence of free carbides causes increased mineral hardness and wear resisting qualities. Such steels are used for tools, rolls, dies, ball and roller bearings, files, cutlery, etc. In combination with other alloying elements, such as nickel, 1 to 3.5 per cent, we have perhaps the most useful and extensively used of all alloy steels. The effect of nickel is to increase toughness and ductility; the combination forming an extraordinary tough and strong steel of particular value in withstanding shock, in which are present the advantages of both nickel and chromium, without the disadvantages of either one separately. Such steels are the only steels which will successfully meet the exacting demands of armor plate, projectiles and ordnance, as well as the more peaceful requirements of the automobile manufacturer; and are used for a wide variety of purposes from the smallest machine parts to forgings of the largest size. Nickel chromium steel suitable for structural purposes with .40 per cent carbon, 3.5 per cent nickel and 1.5 per cent chromium when properly heat treated may have an elastic limit of over 200,000 pounds per square inch with an elongation of 15 per cent and a reduction of area of 45 per cent. In addition, as castings, nickel chromium steels have been successfully used in place of manganese steel for track intersections at street crossings; being both resistant to wear and deformation, and being machinable, a decided advantage over the intractable manganese steel.

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For carburizing and case hardening purposes the nickel chromium steels possess decided advantages. Penetration is more rapid, the surface will become very hard, and there is not the same liability to brittleness and spalling of the carburized layer as with straight carbon steels. The class of work covered by case hardened nickel chromium steels covers a very wide range, from the small gears used in automobiles up to armor plates weighing 75 tons or more.

In addition to alloying with nickel, chromium gives a valuable steel when alloyed with vanadium; the chrome vanadium steels having particular efficiency when used under conditions of shock and repeated stresses. For such reasons they find extensive application in automobile construction as springs, frames, etc., and also for locomotive forgings, connecting rods, axles, wrist pins, etc. Chromium is much used in combination with other alloying elements, and we have chrome nickel vanadium, chrome nickel molybdenum, chrome tungsten, etc., in almost endless variety; all of which are excellent steels, but through lack of space can be no more than mentioned.

Magnet Steels.

The development of chromium magnet steels received its greatest incentive from the tungsten shortage during the war. These steels, on account of their more moderate cost, as compared with tungsten steels, have been found a very satisfactory substitute where highest quality in the material is not essential. On this account they are used largely for magnetos and the more inexpensive kinds of electrical apparatus. But where the highest coercive strength and the greatest permanence is necessary the tungsten and high cobalt steels are superior. In composition, the chromium magnet steels run from .80 to 1.00 per cent carbon with 2 to 4 per cent chromium. The low carbon low chromium steels are water hardening, the higher steels are oil hardening.

High Speed Steels.

The use of chromium in high speed steels is well known, the usual content being from 3 to 5 per cent. While the exact manner in which it acts is still somewhat a matter of discussion, there is no question but that it is a necessary and essential ingredient. Chromium in combination with carbon, as we have seen, causes the suppression of the A_1 transformation, and upon this "self hardening" depends. In investigating the hardness of tempered high speed steels, Edwards

and Kikkawa* in experimenting with two series of chrome tungsten steels of constant carbon content, one with variable chromium, the other with variable tungsten, found that the effect of tungsten was small unless present in greater proportion than 12 per cent; but that with .60 per cent carbon and 18 per cent tungsten, 3 per cent chromium was sufficient to produce self hardening properties. A steel with 6 per cent chromium and .63 carbon possessed the property of self hardening in much greater degree than one containing 18 per cent tungsten. The hardness of the pure chromium steel progressively increased, even with slow rates of cooling, as the initial temperature was raised from 1475 deg. F. to 1850 deg. F.; while no hardening occurred when pure tungsten steels were cooled under exactly similar conditions. As regards tungsten the same authors found that its action, in the absence of chromium, was to raise the temperature at which tempering or softening began; but with chromium present it also had the effect of increasing the secondary hardness, hence its importance in tool steels.

This effect has been explained by Bain and Jeffries† as due to the formation of an iron tungsten carbide when the temperature reaches about 850 deg. F., the particles of which, with further increase in temperature to 1100 deg. F. reach the critical size having greatest tendency to prevent slip. The cause of the secondary or "red" hardness of high speed steel thus being due to the fine grain structure retained by the retarding action of the chromium atoms, and the precipitation of the iron tungsten carbide particles in critical size to prevent slip in an already fine grained structure.

Chromium In Cast Iron.

The effect of chromium when added to cast iron is to stabilize the combined carbon, thus increasing its proportion through the formation of the chromium carbides. Advantage of this property has been utilized commercially by the addition to foundry charges of pig iron produced from the Mayari district in Cuba. This iron usually contains, as natural ingredients, about 1 per cent nickel and 2 per cent chromium with smaller quantities of vanadium and titanium, phosphorus and sulphur being relatively low. The effect of nickel in cast iron is to toughen the ferrite, giving rise to a sorbitic rather than pearlitic structure; also to facilitate the precipitation of graphite. The combined effect of the nickel and chromium, through the addition to cupola mixtures of various proportions (10 to 25 per cent or more) of Mayari pig, is to produce a cast iron with much closer grain structure, and consequent increase in strength and wear resisting qualities. The percentage of combined carbon may be controlled by the content of silicon present, high silicon producing a "greyer" and more machinable iron. Low silicon Mayari iron castings, which are "whiter", and very hard and tough, have been used for parts of rock crushing machinery, hot forming dies, grinding plates, sand pump liners, carwheels, etc. The grey high silicon Mayari irons, on account of machinability, have given very successful service when used for automobile engine parts, cylinder blocks, pistons, etc.

Owing to the heat resisting qualities of nickel and chromium, iron castings containing these in small proportion give reasonably good service at a low red

heat, and have been used in glass works for bottle molds and plungers, also for gas producer valves, furnace arms, grate bars, etc. For such purposes the castings low in silicon and graphitic carbon have given the best results.

Stainless Steels.

A most important property of the metal chromium is its unusually great resistance to chemical attack. This property has been utilized in the development of the so-called "stainless" steels, which were developed independently by Brearly in England, and by Haines in this country some 12 or 13 years ago; and which may be regarded as important an advance in metallurgy as the development of high speed steel. In these steels the chromium content is in excess of that required for the formation of the carbides, and hence a considerable proportion is present in solid solution with the iron.

The stainless steels contain from about 10 to 15 per cent chromium, the carbon varying from .30 to .35 per cent for steels used for cutlery, to .15 to .20 per cent for steels where the stainless quality is of more importance than maintenance of a cutting edge, and to .10 per cent or less for the "rustless irons". Due to the large proportion of chromium, these steels are "self hardening", and may be hardened by cooling in air as well as quenching in oil. The properties may be varied considerably by heat treatment and such variations have a profound effect upon the corrosion resistance qualities. Stainless steel with 13 to 14 per cent chromium and .40 per cent carbon when air quenched, in small pieces, from 1850 deg. F. or over has a martensitic structure, the carbon and chromium being held in solution. On reheating for tempering there is little change below 900 deg. F., above this tempering takes place rather suddenly, Brinell hardness falling from about 500 at quenching to 200-250. Tempering above 1300 deg. reduces Brinell hardness to 200 or less, the steel consisting of precipitated carbide particles embedded in a matrix of ferrite with chromium in solution. The A_c change begins at about 1400 deg. to 1450 deg. F., the carbides gradually going into solution, until at about 1850 deg. a homogeneous structure is again obtained.

With any given stainless steel the greatest resistance to corrosion is obtained after such treatments as will retain the maximum chromium in solution; while the steel will be least resistant when the solid solution has dissociated into separated carbides and ferrite, because of the electrolytic action which thus becomes possible between the various constituents, as well as the reduced concentration of chromium in the iron. Hence, to obtain maximum resistance to corrosion the steel must be quenched from a temperature sufficiently high to dissolve all carbides. In practice it is found that 1750 deg. for oil hardening, and 1850 deg. F., for air hardening give the best results. Until softened by tempering, that is up to 900 deg. or 950 deg., there is little alteration in corrosion resistance, but above that temperature this fails with decreasing hardness.

As the property of resisting corrosion is contained largely in the chromium, the corrosion resistance of a steel will be greater for a given chromium content the lower the percentage of carbon; while conversely, with constant carbon corrosion resistance will be increased with greater chromium. With the very low carbon content of stainless iron (.10 per cent or under) the

*Journal Iron and Steel Inst. 1915, II, 6.

†The Iron Age, 112, 805.

largest proportion of chromium is retained in solid solution, and as there can be but little carbide formed there will be small change even with full tempering. Such stainless iron cannot be hardened, as before noted, (Brinell of 350 may be reached, however) and shows good stainless qualities in the annealed condition, but this may be improved somewhat with proper heat treatment.

Cold working, resulting in strained and distorted metal, increases the tendency to attack by corroding agents, as in the case with metals in general. Consequently a polished or smoothly machined surface on stainless steel is less liable to attack, not because of the polish itself, but because the polishing operation has removed the surface layer of distorted metal caused by rough machining. If the skin of the steel be scratched or torn at any point, then there is liability of attack at that point because the metal has been cold worked to some extent. Similarly, because of the distorted metal cold pressed articles and parts, unless made from steel with very low carbon content, will not have maximum corrosion resistance until properly heat treated. Scale which forms on heating to a bright red heat, is an important factor in facilitating corrosion since it is electronegative to the metal. Hence, articles made of stainless steel should be machined or ground all over, or have the scale completely removed by pickling. Sand blasting is apparently not effective as there is a tendency to force particles of scale into the surface of the metal.

Stainless steel of the usual composition, .30 to .35 per cent carbon, has valuable properties in addition to its stainless qualities. It can be made into satisfactory castings, and is sufficiently malleable to be rolled into rods and sheets, although the lower carbon stainless iron is perhaps better for such purposes. It has exceptional physical properties, equal if not superior to those of any other steel; moreover, owing to the high tempering range such properties are retained at high temperatures where carbon steels show decided softening. Air hardened, and tempered at 1100 deg. F. it will show a tensile strength of nearly 200,000 pounds per square inch with a yield point (drop of beam) of 170,000 pounds, and an elongation of 10 per cent and reduction of area of 33 per cent. Because of its greater heat resisting qualities the familiar temper colors are not assumed until considerably higher temperatures are reached; the difference being about 500 deg. F. for purple and blue.

As its name indicates stainless steel is practically immune to atmospheric corrosion. Samples have been exposed to all kinds of weather conditions, wet and dry, snow and rain, for months at a time and afterward found perfectly bright and unaffected in any way. Likewise it is immune to attack by the ordinary acids and chemicals met with in the household. Rather curiously, while affected slightly by citric, acetic and lactic acids, it is absolutely unaffected by lemon juice, vinegar, or sour milk. Because of these properties it is used for the manufacture of canning and preserving machinery, where containers and parts are subject to the action of vegetables and fruit acids, and for high grade cutlery and tableware. Other applications are for steam turbine blades, where it has given more efficient service than any other material, pump rods and valves, refrigerating and soap making machinery, valves for internal combustion engines, dental and surgical instruments, etc. Since it is only affected

slightly by salt air it is employed in a variety of marine uses. While unattacked, or only slightly, by organic acids in general, or by caustic alkalis, mineral acids such as sulphuric and hydrochloric attack it rapidly in any concentration. Nitric acid, however, has no effect in either dilute or concentrated solutions, even when boiling hot.

The use of low carbon rustless iron has been advocated for roofing materials, automobile bodies, cooking utensils which may be pressed or stamped, etc.; and when the cost of the material has decreased which, judging from present indications will be soon, there is every reason to believe that a large tonnage production will be necessary to meet the demands created by its usefulness. It has good physical properties, 40,000 pounds tensile strength in the annealed condition which may be raised to 80,000 by air hardening, and has the advantage that owing to its softness it may be worked like mild steel, although the procedure is somewhat different.

The addition of other elements, such as nickel and silicon, which are themselves considered acid resisting has been investigated by Monypenny*. Up to about 1 per cent, silicon appears to have no effect upon corrosion resistance; higher percentages raise the critical range and diminish air hardening capacity, which in turn affects corrosion resistance. Nickel, on the other hand, lowers the critical range and increases hardening capacity. Up to 2 per cent there is no change in corrosion resistance, but with larger proportions of nickel the steels become austenitic with greatly increased resistance to mineral acids. In fact a steel has been prepared† containing .60 per cent carbon, 16 per cent chromium with 7 per cent nickel which has given very satisfactory results under test. It is virtually a stainless steel with nickel added.

High Chromium Alloys.

Steels, or rather alloys, with higher carbon and still higher chromium content are austenitic on air cooling, and somewhat resemble manganese steel in being hard to machine. The stainless quality is preserved in these alloys, but owing to their increased cost are not desirable for such uses alone. It is an often repeated statement that no one alloy will satisfy all requirements; where one alloy is forgeable and machinable it fails in oxidation resistance, or if oxidation resistant it is not abrasion resistant and so on. However, there is no question but the high chromium alloys possess many of the valuable properties in combination that are missing from other alloys; nor are the properties of such alloys yet sufficiently recognized by those interested in metallurgical and chemical industries. There alloys combine resistance to high temperatures, both as regards oxidation and physical properties, as well as resistance to abrasion and attack by corroding agents, and although doubtless expensive as regards first cost will, on account of freedom from shut-downs for repairs and replacements, probably be found much more economical in the long run. Once the idiosyncrasies of their manufacture are overcome, a large field of usefulness can safely be predicted for them in the manufacture of retorts for chemical processes, ore roasting furnace parts, oil burning equipment, oil cracking stills, rock crusher parts, etc.

*Trans. Faraday Society, 19, 169.

†Rev. de Metallurgie. Memoires, Sept. 1923.

The Power Show in New York

THOUSANDS of eminent engineers from all parts of the United States and Canada, and several score from European countries visited the Power Exposition in Grand Central Palace. Toronto, Montreal and the great mineral and timber territories that lie to the north of those cities were represented by more than 200 men in various lines, intent on inspecting the latest methods of producing power and the most efficient means of utilizing and conserving it. On the same mission were thousands of American experts in power production and utilization besides a formidable delegation from Pittsburgh, Chicago and Cleveland, the great steel-producing areas.

Local and visiting engineers displayed much interest in the latest proposal concerning Muscle Shoals which would turn the project over to a private corporation for the production of chemicals, fertilizers, power and explosives if occasion demanded. Visitors at the Pal-

ace consider the Alabama water plant one of the most important engineering efforts of all time and are naturally interested in the disposal that is made of it, and particularly the attitude the Senate will take this week when the matter is laid before it.

"My advice would be to turn Muscle Shoals over to the States that would benefit by the power it will produce," was the comment of one of the most prominent engineers at the Exposition. "Let it be used to develop Alabama, Tennessee and the Carolinas industrially, as the Piedmont section has been developed. In my opinion Muscle Shoals cannot produce enough fertilizer in the form of nitrates even to affect the price of that commodity."

In the number and variety of exhibits, and particularly in the use of electrical power to illustrate the operation of the machines, the present display was far ahead of previous exhibitions. Nearly every space in



Few have an adequate comprehension of the magnitude of the Grand Central Palace. These views show the beauty of the arrangement.

the Show was hooked up with outside current, the result being that the entire exhibition resembled to a certain extent a great plant in operation, with wheels whirring and industrial operations going along as they would in a manufacturing plant.

Methods of preventing loss, not only of human life, but of created energy, appear to have engaged much of the attention of inventors and engineers. Second in importance, if the Power Show may be taken as a criterion, would appear to be the effort to replace man power through mechanical ingenuity, especially in the more strenuous forms of effort.

There was, for instance, at this Power Exposition, a miniature power house, with its coal supply spread over an extensive yard. Ordinarily, under such conditions, dozens of men with wheelbarrows would work steadily to keep the boilers supplied with coal. The exhibit shows how one man operating a winch and windless with an automatic shovel can pick up the fuel from all parts of the yard and elevate it into a hopper from whence the supply is available at the furnace doors as it is required. The same shovel is utilized for the removal of ashes.

Apart from absolute carelessness friction is the greatest waster of created energy in the world. Gears and gearing personify friction. Hence there is a constant effort to make gears work more smoothly and efficiently, and in dozens of the exhibits at the Palace the results obtained through the use of correct metals and accurate cutting may be studied. There is no question that in modern gearing the frictional losses are close to the minimum.

Mechanical practice in the construction of motor cars has become so nearly standardized that engineers and designers are more than ever on the lookout for new ideas that can be utilized to effect improvement and at the same time furnish the element of novelty that may add to sales volume. Every possible angle of the car is being studied to ascertain if radical improvement is possible, and the research engineers in other lines are watched closely for ideas that may be turned to account.

New application of power and new types of machines applicable to motor car production annually make their first appearance at the Power Show and attract many representatives of the engineering departments of the big motor companies.

Many remarkable discoveries and improvements in the electrical and radio field have interested millions of people since the Power Exposition was organized two years ago. Many of the exhibits at the Exposition among the 250 displays were intimately connected with radio.

Other interesting advances in electricity have been made in the X-ray field, and also in the manufacture of precision instruments, which are truly phenomenal features of apparatus. As for the heavier power machinery for foundry, blast furnace, road-building, transportation, mining, heating, armament, naval machinery, hydraulic and steam engineering, etc., there was much that was new.

Not the least interesting feature of this Power Show was the series of industrial films shown.

"Wizardry of Wireless" is the title of a two-reel film. With pictures and animated drawing showed the electrical action and function of the vacuum and other apparatus employed in radio transmission and reception. This is only one of several out of the ordinary films that were shown. The "Panama Canal"

is a film record of one of the most difficult engineering feats ever accomplished, from the blasting of the first barrier to the finished canal, with ships passing through the lock.

The "Electrical Giant" is another pictured story of the largest single power-producing unit in the world, namely the 50,000-horsepower steam turbine generator. "The Potter's Wheel" showed the making of electrical porcelain, from the first step in mixing the ingredients to the final polishing of the finished product.

"Big Deeds" is the title of a spectacular reel that showed a few big scenes from five big subjects. The first is pouring the largest casting ever made in the General Electric Foundry. The second, work on the largest armored cable in the world, which will supply power to the industries of Shanghai, China. Third is a picture of the huge electrical porcelain insulator that is so large a man can stand upright inside of it. Fourth is the largest one-man shovel on the face of the earth. At Saltillo, O., 300 cubic yards of surface earth are being moved daily from the coal mines with this shovel. Last but not least is shown the process of melting steel with water, ending with a spectacular scene showing a 15-inch plate giving way to the terrific heat.

"Revelations by X-Ray" portrays clearly the work that is being done with this modern achievement, while the "Conquest of the Forest" gives one a clear idea of the magnitude of the lumber industry that is being carried on in the Northwest. "Beyond the Microscope" shows with animated drawings the structure of atoms, while motion pictures show how water is produced by exploding two gases. Another unusual film portrayed the visit of Thomas A. Edison through the laboratories of the General Electric Company. Dr. W. R. Whitney, the late Dr. Charles P. Steinmetz and other eminent scientists are in this interesting portrayal. The two-reel film, "The World of Paper," takes the history of paper from its beginning up to today and shows the modern press in contrast to the old-time methods.

How to bandage the eyes in order to see the remarkable total eclipse of the Sun on January 24 was told before a distinguished gathering of scientists, engineers, college professors and others at the Power Show by Prof. B. G. Way, secretary of the astronomical division of the Brooklyn Institute of Arts and Sciences. Prof. Way, widely known as an authority on astronomy, told some interesting things about this eclipse—how to observe its strange phenomena, how to photograph it—and what not to do, were some of the things he mentioned.

Electro-Metallurgical Applications

(Continued from page 25)

"Electrometallurgy of Zinc," American Electrochemical Society, October, 1921—W. R. Ingalls.

"Commercial Production of Electrolytic Iron", Mining and Metallurgy, December, 1921—C. P. Perin and Donald Belcher.

"Electrolytic Iron Refining", Chemical and Metallurgical Engineering, April 5, 1922—G. F. McMahon.

"Magnetic Properties of Compressed Powdered Iron"—A. I. E. E., July, 1921—Speed and Elmen.

"Metallurgical Plants in the Vicinity of New York", Engineering and Mining Journal, June 12, 1920—E. H. Robie.

"Metallurgical Report, New Cornelia Copper Company", Mining and Metallurgy, June, 1923, Page 299.



Views of a number of the interesting booths at the New York Power Show.

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Complete Program of the A. S. M. E. Convention

A most elaborate program was presented by the A. S. M. E. at the Engineer's Building in 39th Street, throughout the week of the power show. So important were these co-ordinated activities, and so wide-spread the interest invoked that the complete program of the technical sessions, conferences and business meetings is herewith re-printed; 26 subdivisions in all.

Oil Handling and Storing.

Under auspices of Materials Handling Division. Presiding officer, J. A. Shepard, member of the executive Committee, Materials Handling Division.

"The Storage and Handling of Fuel Oil in Industrial Plants." By C. G. Sheffield, Fuel Oil Department, Standard Oil Company of New Jersey, New York, N. Y., and H. H. Fleming, Jun. A. S. M. E., refinery engineer, Standard Oil Company of New Jersey, Elizabeth, N. J.

Research in Machine Design and Operation.

Under auspices of Research Committee on Cutting and Forming of Metals and Machine-Shop Practice Division. Presiding officer, B. H. Blood, chairman of Research Committee on Cutting and Forming of Metals.

"Comparison of 'Herbert Pendulum Hardness Tester with Other Hardness Testers.'" By J. O. Keller, Jun. A. S. M. E., professor of Industrial Engineering, Pennsylvania State College, State College, Pa.

"Preliminary Progress Report of the A. S. M. E. Special Research Committee on Metal Springs." Presented by Joseph K. Wood, chairman of the Special Research Committee on Metal Springs.

Textile Session.

Under the auspices of Textile Division. Presiding officer, G. H. Perkins, vice chairman of Textile Division.

"The Development of the Spinning Frame." By Robert E. Naumburg, member A. S. M. E., head of Patent and Research Department, Saco-Lowell Shops, Lowell, Mass.

"The Engineer's Field in Industrial Economics." By Eugene Szepesi, member A. S. M. E., engineer and economist, Szepesi Industrial Organization, Boston, Mass.

General Session.

Auditorium, third floor. Presiding officer, W. H. Kenerson, vice president of the Society.

"The Strength and Proportions of Wheels, Wheel Centers, and Hubs." (To be read by title.) By R. Eksbergian, member A. S. M. E., engineer, Baldwin Locomotive Works, Philadelphia, Pa.

"The Turbine Designer's Wind Tunnel." By H. Loring Wirt, Turbine Engineering Department, General Electric Company, Schenectady, N. Y. The paper describes air-testing methods developed by the General Electric Company for testing elements of turbines, such as nozzles, exhaust hoods, etc., by simulating the conditions in the turbine and determining the effect on models of the elements.

"Test of a Prosser-Type Reciprocating Steam Engine." By L. V. Ludy, A. S. M. E., Professor of Experimental Engineering, Purdue University, Lafayette, Ind. A description of the Prosser reciprocating steam engine and the results of 53 trials made of it at Purdue University.

Joint Session with American Society of Refrigerating Engineers.

Presiding officer, George A. Horne, president, A. S. R. E.

"Some Factors Influencing Friction, Velocity Distribution, and Heat Transmission, for Fluids Flowing Inside Pipes. (Contributed by A. S. R. E.) By W. H. McAdams, professor of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

"The Temperatures of Evaporation of Water Into Air." (Contributed by A. S. M. E.) By W. H. Carrier, member A. S. M. E., president, and D. C. Lindsay, physicist, Carrier Engineering Corporation, Newark, N. J.

"Water Cooling System Efficiency." (Contributed by A. S. M. E.) By Victor J. Azbe, member A. S. M. E., consulting engineer, St. Louis, Mo. Formulas and charts for use in predetermining performance of water-cooling systems for power and refrigerating plans at different seasons, and discussion of the cooling possibilities under different weather conditions and in different sections of the country.

Machine-Shop Practice Session.

Under auspices of Machine-Shop Practice Division. Presiding officer, F. O. Hoagland, member of the Executive Committee, Machine-Shop Practice Division.

"The Effect of Inaccuracy of Spacing on the Strength of Gear Teeth." By Lloyd J. Franklin, Jun. A. S. M. E., San Bernardino Ice & Precooling Plant, San Bernardino, Cal., and Charles H. Smith, instructor in Mechanical Engineering, Stanford University, Cal. An extension of the work reported to the Society by Professor Guido Marx in 1912. It is shown among other things that in a broad way, at pitch-line velocities of from 0 to 1000 ft. per min., gears whose inaccuracies of spacing do not exceed 0.001 in. will carry twice the load of those having inaccuracies of 0.006 in.

"Mechanical Springs." By Joseph Kaye Wood, associate member A. S. M. E., Consulting Engineer, New York, N. Y.

"Ruling Line Standards." By Herbert B. Lewis, Brown & Sharpe Mfg. Company, Providence, R. I., and C. G. Peters, Bureau of Standards, Washington, D. C.

Session on Turbo Locomotives.

Under auspices of Railroad Division. Presiding officer, Wm. Elmer, vice chairman of Railroad Division.

"The Zoelly Turbine-Driven Locomotive." By H. Zoelly, chairman of Board of Directors, Escher Wyss & Co., Zurich, Switzerland. Gives particulars regarding a 1,000-hp. experimental condensing locomotive driven by a 6-stage impulse turbine and employing

a cooler for the condensing water in which air is brought into intimate contact with the water, heated and saturated with vapor, the heat necessary for vaporization being withdrawn from the water to be cooled.

"The Ramsay Condensing Turbo-Electric Locomotive." By George F. Jones and T. Laurence Hale, of London.

Power Test Codes, Public Hearing.

Presiding officer, Fred R. Low, president of the Society and chairman, Main Committee on Power Test Codes.

"Public Hearing on Power Test Codes for Solid Fuels, Gas Producers, and Speed Responsive Governors."

Lecture.

Under auspices of Fuels Division. Presiding officer, Fred R. Low, president of the Society.

"Engineers and the American Petroleum Situation." By Dr. Julian D. Sears, administrative geologist, U. S. Geological Survey, Washington, D. C.

Presidential Address and Reception.

"Power." Address by Fred R. Low, president of the Society. Report of tellers of election of officers, introduction of president-elect, and reception by the society to the president, president-elect, ladies, members and guests.

Session on Oil Burning.

Under the auspices of Fuels and Power Divisions. Presiding officer, E. H. Peabody, president, Peabody Engineering Corporation, New York, N. Y.

"Fuel-Oil Burning in the United States Navy." By H. G. Donald, Lieut.-Com. U. S. N., Fuel-Oil Testing Plant, U. S. Navy Yard, Philadelphia, Pa.

"Oil Burning in Industrial-Plant and Central-Station Service." By Nathan E. Lewis, member A. S. M. E., mechanical engineer, Babcock & Wilcox Company, New York, N. Y.

"Hazards of Industrial Oil Burning." By H. E. Newell, engineer, National Board of Fire Underwriters, New York, N. Y.

Session on Lubrication.

Under auspices of Machine-Shop Practice Division and Special Research Committee on Lubrication. Presiding officer, A. Kingsbury, chairman of Special Research Committee on Lubrication.

"An Investigation of the Critical Bearing Pressures Causing Rupture in Lubricating-Oil Films." By Leonard Noel Linsley, Lieut.-Com. U. S. N., U. S. S. Wright.

"High-Pressure-Bearing Research." By Louis Illmer, member A. S. M. E., development engineer, Brewer-Titchener Corporation, Cortland, N. Y.

"A Graphical Study of Journal Lubrication (Part II)." By H. A. S. Howarth, member A. S. M. E., general manager and chief engineer, Kingsbury Machine Works, Philadelphia, Pa.

Session on National Defense.

Under auspices of National Defense Division. Presiding officer, Major Fred J. Miller, chairman of National Defense Division.

"The Engineering of National Defense." By Dwight F. Davis, Assistant Secretary of War.

"Some Problems in the Design of Ordnance." By J. B. Rose, Major, U. S. A. In command, Artillery Division, Ordnance Office, Washington, D. C.

"X-Ray Examination of Metals at the Watertown Arsenal, Watertown, Mass." By T. C. Dickson, Colonel, Ordnance Department, U. S. A., Watertown, Mass. Experience with a 280,000-volt X-ray equipment employed to determine defects in steel castings with a view to redesign of the patterns to eliminate the defects.

"New Developments in Gun Construction." By F. C. Langenberg, metallurgist, Watertown Arsenal, Watertown, Mass. An address having a very great practical bearing on other engineering matters than that of gun construction.

Mechanical Design for Safety.

Under auspices of A. S. M. E. Committee on Safety Codes and A. S. S. E.—Engineering Section—N. S. C. Presiding officer, C. B. Auel, president, National Safety Council and member of A. S. M. E. Committee on Safety Codes.

"The Hazards of Pulverized Fuel Systems." By H. E. Newell, engineer, National Board of Fire Underwriters, New York, N. Y., and Robert Palm, member A. S. M. E., consulting engineer, New York, N. Y.

"A Place for Safety." By Lewis A. DeBlois, manager, Safety Division, E. I. DuPont de Nemours & Company, Wilmington, Del.; past-president, National Safety Council.

Business Meeting.

Presiding officer, Fred R. Low, president of the Society.

Presentation to the society of the bust of Rear-Admiral Melville. Presentation made by Walter M. McFarland, chairman of Special Committee on Melville Bust.

Annual Report of Council.

Presentation of Awards: Junior prize to R. H. Heilman, Pittsburgh, Pa.; student prizes to (1) George Stuart Clark, Stanford University, Cal., and (2) L. J. Franklin and Chas. H. Smith, Stanford University, Cal.

Standards to Be Read by Title: Revised National (American) Standard Fire Hose Coupling Screw Thread, and (2) Proposed Standard for Tolerances and Allowances for Machined Fits in Interchangeable Manufacture.

Steam Tables Research.

Presiding officer, A. M. Greene, Jr., member of Executive Committee, Steam Table Fund.

"Report of Executive Committee, Steam Table Fund." By George A. Orrok, member A. S. M. E., New York, N. Y., chairman of the committee.

"Research Progress Reports." By N. S. Osborne, physicist, Bureau of Standards, Washington, D. C., and F. G. Keyes, Massachusetts Institute of Technology, Cambridge, Mass.

"Summation of Research Results." By Harvey N. Davis, member A. S. M. E., professor of Mechanical Engineering, Harvard University, Cambridge, Mass.

Session on Education and Training for the Industries of Non-College Type.

Under auspices of committee on Education and Training for the Industries. Presiding officer, John T. Faig, chairman, committee on Education and Training for the Industries.

"Industry's Interest in Industrial Training." By Magnus W. Alexander, managing director, National Industrial Conference Board.

"Industrial Education — A Summary of the Work of the American Management Association and Its Predecessors." By George B. Thomas, educational director, Western Electric Company.

"Training for the Industries and the Public Program of Vocational Education." By Frank Cushman, chief of the Industrial Education Service, Federal Board for Vocational Education.

"The Need for District Organization of Modern Apprenticeship." By H. A. Frommelt, apprentice superintendent, Falk Corporation.

Student Branch Conference.

Presiding officer, Prof. W. H. Kenerson, chairman of committee on Relations with Colleges.

"Conference of Student Branches of the Society."

Aeronautic Session.

Under auspices of Aeronautic Division. Presiding officer, S. A. Moss, chairman of Aeronautic Division.

"Equipment Used for Aerial Surveying." By Ernest Robinson, member A. S. M. E., vice president, Fairchild Aerial Camera Corporation, New York, N. Y.

"An Introduction to the Helicopter." By Alexander Klemin, associate member A. S. M. E., associate professor of Aeronautics, in charge of Aero-dynamic Laboratory, New York University, New York, N. Y.

"Production Airplanes of Metal." By Edmund Burke Carns, Jamaica, L. I., N. Y.

Steam Power Session.

Under auspices of Power Division. Presiding officer, N. E. Funk, chairman of Power Division. Announcement of time of presentation of each paper will be made by presiding officer.

"Water Treatment for Continuous Steam Production." By R. E. Hall, physical chemist, Mining Experiment Station, U. S. Bureau of Mines, Pittsburgh, Pa.

"The Increase in Thermal Efficiency Due to Resuperheating in Steam Turbines." By W. E. Blowney and G. B. Warren, junior members A. S. M. E., Turbine Engineering Department, General Electric Company, Schenectady, N. Y. The results given in the paper show that the heat consumption of a turbine installation may be decreased six to seven per cent as a result of resuperheating the steam. This paper is published in full in the Power Section of this magazine.

"A Review of Recent Applications of Powdered Coal to Steam Boilers." By Henry Kreisinger, member A. S. M. E., research engineer, Combustion Engineering Corporation, New York, N. Y.

"Recent Developments in the Burning of Anthracite Coal." By W. A. Shoudy, superintendent of Steam Stations, Adirondack Power & Light Corporation, Schenectady, N. Y., and R. C. Denny, Test and Research Department, Combustion Engineering Corporation, New York, N. Y. Report of experimental work on 1,345-hp. stoker-fired boilers burning small sizes of anthracite, with particulars of furnace design that eliminated stratification and ignition troubles.

Session on Management.

Under auspices of Management Division and Taylor Society. Presiding officer, R. T. Kent, chairman of Management Division.

"Shop Management." By Frederick W. Taylor, to be presented by Morris L. Cooke.

"Presentation of Resolutions in Honor of Frank B. Gilbreth."

"The Development of a Modern Hosiery Plant." By Sanford E. Thompson, member A. S. M. E., the Thompson and Litchner Company, Engineers, Boston, Mass., and H. T. Rollins, president, Rollins Hosiery Mills, Des Moines, Iowa.

Session on Management and Machine-Shop Practice.

Under auspices of Management and Machine-Shop Practice Divisions and Taylor Society. Presiding officer, Richard A. Feiss, president of Taylor Society.

"Production Control." By George D. Babcock, manufacturing executive, Holt Manufacturing Company, Peoria, Ill.

"Design, Manufacture, and Production Control of a Standard Machine." By Ralph E. Flanders, member A. S. M. E., manager, Jones & Lamson Machine Company, Springfield, Vt.

Session on Oil and Gas Power.

Under auspices of Oil and Gas Power Division. Presiding officer, Elmer A. Sperry, chairman of Oil and Gas Power Division.

"Solid-Injection Oil Engines." By R. Hildebrand, member A. S. M. E., chief engineer, Diesel Division, Fulton Iron Works, St. Louis, Mo.

"Large Oil Engines, with Special Reference to the Double-Acting Two-Cycle Type." By Charles Edward Lucke, member A. S. M. E., professor of Mechanical Engineering, Columbia University, New York, N. Y.

"Gas Turbines." By Lionel S. Marks, member A. S. M. E., professor of Mechanical Engineering, Harvard University, and M. Danilov, junior A. S. M. E. Research Work, General Electric Company, Lynn, Mass.

Hydraulic Session.

Under auspices of Power Division. Presiding officer, Wm. F. Uhl, hydraulic engineer, Chas. T. Main, Boston, Mass.

"A Method for the Economic Design of Penstocks." By H. L. Doolittle, member A. S. M. E., assistant construction engineer, Southern California Edison Company, Los Angeles, Cal.

"Intakes for Power Plants." By Robert W. Angus, member A. S. M. E., professor mechanical engineering, Faculty of Applied Science and Engineering, University of Toronto, Toronto, Canada.

Lecture.

Auditorium, third floor. Presiding officer, Fred R. Low, president of the Society.

"Properties of Matter Under High Pressure." By P. W. Bridgman, professor of physics, Harvard University, Cambridge, Mass.

Presiding officer, Fred R. Low, president of the Society.

"Progress Conference of Technical Committees of the Society."

Under joint auspices Engineering Societies and Schools.

"Carnot Centenary." Carnot's Principle, Dr. Michael I. Pupin. Carnot's Influence upon Engineering, Dr. Wm. Leroy Emmet.

Electric Motor Drive for Centrifugal Compressors

A General Discussion of This Type Centrifugal Fan, with Tables of Power Requirements and Characteristic Curves

By GORDON FOX*

THE centrifugal compressor is essentially a special type of centrifugal fan. As such, it parallels the latter closely in general characteristics and performance. The centrifugal compressor is more ruggedly built than the fan, and is thus enabled to run at higher speeds and to develop and withstand higher pressures. It is inherently a high-speed equipment. The impeller of a centrifugal compressor ordinarily carries a moderate number of blades which are in general backward inclined, the curvature being varied, however, to suit the characteristics desired. In some types diffusing vanes are employed to convert the absolute velocity of the gas leaving the impeller into pressure. In other types, the volute housing alone performs this function. In the matter of efficiency, the centrifugal compressor is representative of the best centrifugal fan practice.

Centrifugal compressors may have a single stage or several stages may be connected in series so that the stage pressures are added. The pressure developed per stage depends upon the density of the air or gas, the impeller diameter, speed, shape of blades and other design factors. Pressures from $\frac{3}{4}$ to 10 lb. per stage are obtained. Compressors are built for low and intermediate pressures ranging from $\frac{3}{4}$ lb. to 40 lb. sq. in., and for high pressures up to 150 lb. per sq. in., and in capacities up to 60,000 or 75,000 cu. ft. per min. The former are often termed centrifugal blowers. The high-pressure machines are necessarily of the multi-stage type and some of the small, low-pressure units are also multi-stage due to the naturally smaller diameters and the limited speeds available with direct connected motors.

Characteristics.

Centrifugal compressors are similar in characteristics to centrifugal fans, with backward-inclined blades. Although the characteristics of individual designs differ, in general the pressure rises from the shut-off point to a higher pressure at some partial delivery. Beyond this point, the pressure developed decreases with increase in volume. The efficiency curve is similar to that of a centrifugal fan, but is commonly somewhat higher. The horsepower curve ordinarily approximates a straight line at partial volumes, but at high capacities the horsepower does not increase in proportion to the volume due to the lesser pressures then developed. The characteristics of a typical single stage compressor are shown in Fig. 1.

A centrifugal compressor which develops maximum pressure at a partial load cannot well be operated entirely shut off, or with greatly reduced delivery, as an unstable condition arises,

leading to surging. Thus the compressor shown in Fig. 1 would not be operated at full speed at delivery less than about 2,500 cu. ft. per min. Ordinarily at reduced speeds the point of instability occurs at lesser deliveries, hence it may be feasible to slow down the unit for periods of light duty.

Power Required.

The theoretical power requirement of a centrifugal fan may be determined by the approximate formula:

$$\text{Air horsepower} = \frac{Q \times h}{6350}$$

Where Q = inlet volume, cu. ft. per min.
 h = pressure, inches of water.

In a centrifugal fan the range of pressures is so low that the air or gas has practically the same density at the inlet and outlet. In a centrifugal or other compressor in which the air or gas is appreciably compressed, the work represented in compression is a factor, and the simple fan formula cannot be used. This formula may be applied to centrifugal compressors for low pressures up to about 30 inches of water, at which pressure the error is about 2.5 per cent. For higher pressures the error is greater.

If air or gas be compressed without the extraction of heat, the temperature will rise as the pressure is increased and the volume diminished. This is called adiabatic compression. If heat be withdrawn constantly during compression, so that the temperature remains constant, the final volume when compressed

TABLE I.

Theoretical Power Required to Compress 100 Cu. Ft. Per Min. Air or Gas at and from Initial Pressure of 14.7 Lb. Per Sq. In. Abs. to Final Pressure of P Lb. Per Sq. In. Gauge.

Final Press No. Ga.	Horse Power Adiabatic Compression	Horse Power Isothermal Compression	Final Press No. Ga.	Horse Power Adiabatic Compression	Horse Power Isothermal Compression
1	0.425	0.422	28	7.99	6.83
2	0.835	0.816	30	8.40	7.13
3	1.22	1.19	35	9.32	7.65
4	1.59	1.54	40	10.21	8.41
5	1.95	1.88	45	11.08	8.96
6	2.31	2.19	50	11.84	9.49
7	2.64	2.50	55	12.60	9.97
8	2.97	2.78	60	13.20	10.41
9	3.28	3.06	65	13.94	10.81
10	3.58	3.32	70	14.60	11.22
11	3.88	3.58	75	15.20	11.60
12	4.17	3.82	80	15.80	11.92
13	4.44	4.06	85	16.35	12.28
14	4.72	4.28	90	16.91	12.59
15	5.00	4.50	95	17.45	12.89
16	5.25	4.71	100	18.00	13.18
18	5.75	5.12	105	18.45	13.45
20	6.24	5.50	110	18.95	13.70
22	6.70	5.86	115	19.41	14.00
24	7.15	6.20	120	19.89	14.20
26	7.56	6.52	125	20.30	14.45

*Electrical Engineer, Freyn, Brassert & Company, Chicago, Ill.

to a given pressure is less than in adiabatic compression. This is termed isothermal compression. In actual compressors more or less cooling effect obtains, but additional heat is also introduced to air and other friction losses. The net result is a condition intermediate between adiabatic and isothermal compression. The power required for isothermal compression is less than that required for adiabatic compression. Table 1 shows the theoretical power required to compress air both isothermally and adiabatically from 14.7 lb. per sq. in. absolute inlet pressure at 60 deg. F. to various gauge pressures.

To determine the actual power requirement, correction must be made for efficiency. For low pressures, up to about 30 lb. per sq. in., efficiencies are generally based upon adiabatic compression. Above this

An impeller, either for a pump, fan or compressor, will, at a given speed, generate a definite head in feet. Thus a pump impeller giving a head of 100 ft. of water will, at the same speed, when handling air, develop a head of 100 ft. of air. Due to the difference in densities, however, the pressures will be entirely different. When handling water the pressure will be $\frac{100}{2.31} = 43.3$ lb. per sq. in. When handling air the

pressure will be $\frac{100}{1890} = 0.053$ lb. per sq. in.

The relations between inlet conditions, density, volume, pressure and power may be most readily shown by an example.

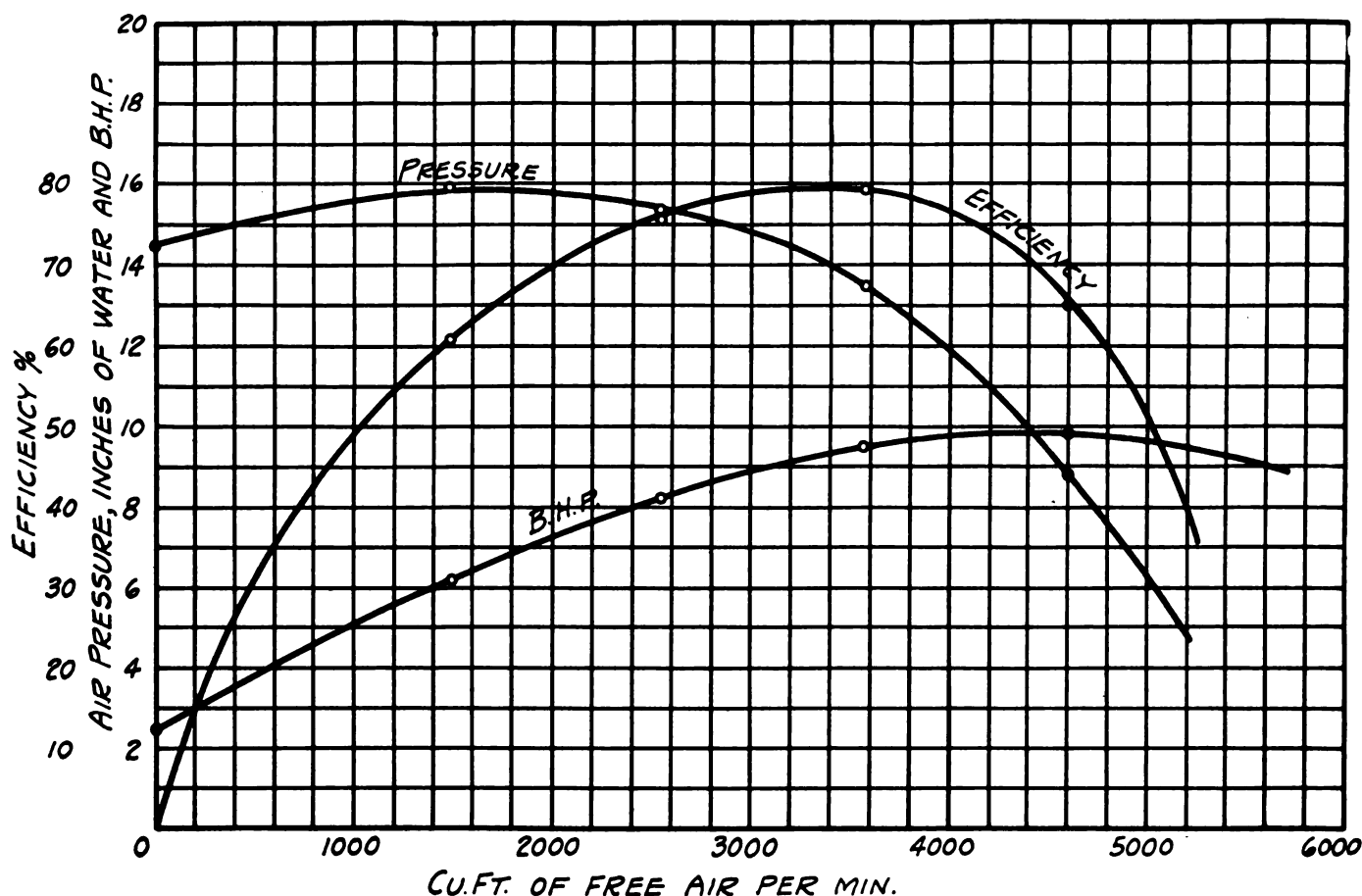


FIG. 1.—Shows the characteristics of a single stage compressor.

point they are based on isothermal compression. The efficiencies of centrifugal compressors at rated load condition, usually representing approximately the most efficient operating point, are on the order of 60 to 70 per cent.

When inlet conditions are other than standard it is necessary to correct the volume to standard conditions before determining the theoretical and actual power requirement. The volume delivered is inversely proportional to the absolute inlet pressure and inversely proportional to the absolute inlet temperature.

The power required depends upon the inlet volume at standard conditions and upon the actual pressure developed. The density of the gas has a direct bearing upon the determination of the compressor needed to develop the required pressure, but the horsepower requirement depends upon the pressure developed and not upon the density except as it affects this pressure.

It is desired to handle 14,000 cu. ft. per min. of coke oven gas, volume being referred to 60 deg. F. and 14.7 lb. absolute pressure, against a net pressure of 32 inches of water, the temperature of the gas at the inlet being 110 deg. F., pressure at the inlet 10 inches water vacuum and the specific gravity of the gas 0.4 referred to air. The procedure may be outlined as follows:

10 in. water = 0.36 lb.

14.7 — 0.36 = 14.34 lb. actual absolute inlet pressure.

Inlet volume equals

$$14,000 \times \frac{14.7}{14.34} \times \frac{460 + 110}{460 + 60} = 15,720 \text{ cu. ft. per min.}$$

32 in. delivery pressure = $32 \times 0.0361 = 1.155$ lb. per sq. in.

Theoretical adiabatic horsepower per 100 cu. ft. from 14.7 absolute to 1.155 lb. gauge pressure, from Table 1, is approximately 0.487.

$$\text{Theoretical hp.} = 0.487 \times \frac{15,720}{100} = 77 \text{ hp.}$$

Let efficiency = 70 per cent.

$$\text{Actual hp.} = \frac{77}{0.70} = 110 \text{ hp.}$$

Density at inlet equals

$$0.4 \times 0.0764 \times \frac{14.34}{14.7} \times \frac{460}{460 + 110} = 0.0272 \text{ lb. cu. ft.}$$

A blower capable of developing 32 in. water pressure with this gas would be rated for the following pressure with standard air:

$$\frac{0.0764}{0.0272} \times 32 = 89.9 \text{ in. water} = 0.0361 \times 89.9 = 3.24$$

lb. per sq. in.

Note: Wt. of 1 cu. ft. standard air = 0.0764 lb.
1 in. water column = 0.0361 lb. per sq. in.

The method of determining horsepower as outlined above is not entirely accurate for inlet pressures below 14.7 lb. per sq. in. absolute, but the error is not great for inlet pressures down to about 14 lb. per sq. in. Formulae for determination of theoretical air horsepower are given in handbooks and texts on thermo dynamics.

Where the delivery pressure specified is static pressure it is important—especially for low-pressure blowers—to add the velocity head to determine the total pressure, the latter being then used in connection with Table 1.

$$\text{Velocity head} = \frac{V^2}{4374} \text{ in. of water for air at standard}$$

conditions where V = velocity, ft. per sec.

Motor Types.

The usual centrifugal compressor, driven at constant speed, has a drooping pressure characteristic as indicated in Fig. 1. A variation of volume can be secured by varying the system pressure, as by a damper, in the same manner as for a centrifugal fan, but at some loss of efficiency. Most small compressors are driven at constant speed and damper control is supplied. Where variation of pressure or volume is desired, particularly over a considerable range, or for the larger equipments, speed control is desirable.

Constant speed compressors in sizes requiring motors up to 200 hp. capacity are commonly driven by squirrel cage induction motors, usually at 3,500 rpm. From 200 hp. to 600 hp. direct connected wound rotor induction motors are generally employed. The wound rotor motor is preferable in these sizes due to restriction of starting current demand and also because of its ability to care for secondary circuit losses incident to acceleration of a load of high inertia. For sizes above 600 hp. direct connected synchronous motors are often applied, these motors being 3,600 rpm. units of the turbine generator type. These motors are of standard construction and have the advantage of direct connection and high power factor. Where speed

control is desirable wound rotor induction motors with secondary resistance control may be used for any capacities. This type of motor is not commonly employed in sizes smaller than 200 hp. For capacities in excess of 500 hp. wound rotor induction motors of 3,600 rpm. for direct connection are not available and lower speed units must be employed, in connection with gear units. A range of 15 to 20 per cent below maximum speed is generally a sufficient range of speed control, but in some cases as much as 50 per cent variation is desired. Due to the light load at reduced speeds, comparatively high secondary resistance is required, this being determined on a "fan duty" basis. Direct current motors in capacities up to about 100 hp. may be arranged for direct connection to centrifugal compressors. For larger sizes step-up gear units are necessary. These motors may be of either constant or adjustable speed type, as desired.

William Whigham Passes

Prominent Carnegie Vice-President Succumbs After Eight Months' Illness.

William Whigham, Vice President of the Carnegie Steel Company, died December 23, after a lingering illness. Thirty-two years of masterful concentration upon the enormous problems of a major steel organization left Mr. Whigham badly prepared to fight a battle for life. He never learned to play. Graduating from Stevens Institute in 1888 he entered the employ of the Homestead Steel Works in 1892.

The greatest monument to his genius and foresight stands the great Clairton By-product Coke Works at Clairton, Pa., and its connecting river and rail transportation systems. This plant, already the largest of its kind in the world, is now being extended, and when fully completed will be more than twice its present size. Mr. Whigham also was in charge of developing the river transportation problem, and was in the forefront of the work of furthering the Ohio River improvement and canalization. During the past few years Mr. Whigham gave close study to marine architecture as it pertained to steam craft for use on inland waters, and on several occasions has designed wholly and in part several steamers of the company's construction which now ply the Monongahela, Ohio and Mississippi Rivers, from Brownsville, Pa., to New Orleans, La.

Besides being vice president of the Carnegie Steel Company, Mr. Whigham was a director of the H. C. Frick Coke Company; Sharon Coal and Coke Company and the Bessemer Electric Power Company. With these activities he found time to serve as chairman of the waterways committee of the Citizens Committee on City Plan of Pittsburgh.

During the World War, Mr. Whigham was a member of the United States Steel Corporation's Committee on Construction of the Neville Island Arsenal, abandoned at the close of the war.

Starting as a draftsman in the Armor Plate Department, he was appointed steam engineer of the works; before entering the city offices as assistant to the president (A. C. Dinkey) he had served as superintendent of the Howard Axle Works, a separate plant division under Homestead superintendence.

More Protection for the Indian Steel Industry

Home Industry Is Entitled to a Discriminating Protection by Tariff

AMERICAN steel manufacturers should be interested in the recommendations made in a report just issued by the Indian Tariff Board. British India is a large potential customer for steel and steel goods but, at the same time, she possesses a developing industry of her own and if the recommendations made in the report referred to are adopted by the Indian government for embodiment in the tariff the home industry will thereby be placed in a position to produce at prices which will compare favorably with those at which foreign goods subject to duty will be able to be imported.

The Board holds the opinion that the home industry is entitled to a discriminating protection by tariff. India can become a large producer of steel. She possesses large deposits of iron ore; she has large coal fields in close proximity to them; further, labor is cheap and plentiful and requires nothing but training to attain a certain degree of efficiency. It would seem curious, therefore, that she is not able at present to produce steel as cheaply as it can be produced elsewhere. This is really so, however, and it is a problem which merits closer examination.

Really, there is only one firm which is capable of producing steel on a large scale in India. This is the Tata Company, which with one or two subsidiary concerns, dominates the Indian steel world. The proposed elaborate protective scheme is therefore being engineered mainly for the benefit of this organization. It was only in 1913 that the Tata Company commenced to produce steel after having taken up the manufacture of pig iron two years previously. During the financial year 1916-1917 its production of steel was about 100,000 tons, a total increased to 126,000 tons five years afterwards. The only kind of steel produced is that made on the basic open-hearth system, as Indian materials do not admit of the manufacture of other sorts. Recently the Tata Company has raised fresh capital and put down a new plant which will shortly come into operation, when an estimated production of 422,000 tons of steel per annum will be possible. With this new plant production will proceed on more economical lines than it did in the past, but still the company has put in an application for a 33 per cent protective duty. There are three other firms in the country which manufacture steel castings but their production is rather elementary. The duties proposed would therefore mainly benefit the Tata Company, and there have not been wanting people in India to voice the opinion that it would have been better for the consumers in general if instead of increasing the import duties the government had given some sort of guarantee to this one concern, but such an idea has been emphatically rejected by the Tariff Board.

The proposed tariff is so designed as to allow the Indian manufacturer to sell his steel at 180 rupees per ton. The Board arrived at this figure after going into the question of what expenditure the Indian manufacturer will be put to in producing his steel and what profit should be allowed him to offer a fair return on his capital expenditure. The duties are more

than doubled, the present 10 per cent duty on various manufactured products being increased by five, ten or fifteen per cent, whilst here and there specific duties have been substituted for the ordinary ad valorem ones.

A section of the report is devoted to the position of those industries which depend directly on the use of steel, such as engineering, wagon building, tin plate, wire, nails and agricultural implements. On fabricated steel the proposed duty would be 25 per cent, but this excludes steamers and various vehicles which contain this material, as it is admitted that at present the Indian industry could not produce these satisfactorily.

The question of how the manufacture of machinery in India is likely to be affected by the proposed duties is recognized to be a very important one and the Board will later undertake an exhaustive inquiry into it. The sole purpose of the present proposals is to protect the steel industry and no alterations are proposed at present in the existing tariff on machinery. This machinery import is to be considered on its broader lines, the cost of steel being only one item to be taken into consideration, and the views of all machinery-using industries will be taken note of when the inquiry takes place.

The Board was faced with a knotty problem as regards railway wagons. It is imperative at the present juncture that railway costs be kept as low as possible and the imposition of the proposed duties will raise the cost of railway wagons by about Rs. 120 per piece. However, it has been considered better to rely at first on outside sources for the bulk of the supply of wagons than to try and build up at once a large industry of the kind in India. Consequently, such wagons entering the country are not to be subject to a protective duty, but a system of bounties to wagon manufacturers is to be resorted to whereby the manufacturers will receive from Rs. 850 to Rs. 440 per wagon as the number of wagons made increases. The former figure is for the first year and represents the difference between current British and Indian quotations plus the additional cost of steel estimated to arise from the imposition of the proposed tariff. As the production in the country increases and the wagons can be marketed more cheaply, the bounty will progressively drop to the lower figure. This bounty system is to remain in operation for five years.

At present all imported tinplate is valued, for customs purposes, at the nominal rate of Rs. 400 per ton and subject to an ad val. duty of 10 per cent. The recommendation will be that tin plate shall in future bear a specific duty of Rs. 60 per ton—a 5 per cent increase in duty. At present there is one tin-plate company at work which draws its supplies of sheet bars from the Tata Company under contract and the new duty will not be high enough to allow the supply of these at a remunerative price at present. However, when the Tata concern has its new plant running it will be able to supply these bars at a price which will not result in its making a loss on the business.

(Continued on page 59)

By-Product Summary

Several Important Additions to the By-Product Oven Industry
Characterize a Year of Exceptional Expansion

By C. J. RAMSBURG*

THE by-product coke and gas industry in the year 1924 was characterized by the completion of more by-product coke oven capacity than in any other year since 1918. A total of 712 ovens, having an annual carbonizing capacity of approximately 6,500,000 tons of coal, were completed and put into operation. An interesting feature of this is the fact that all of this capacity is in the Becker type oven and all plants were designed and built by The Koppers Company.

The following is a list of the plants completed during the year:

By-Product Coke Oven Plants:

Carnegie Steel Company, Clairton, Pa.....	366
Columbia Steel Company, Salt Lake City, Utah.....	33
Republic Iron & Steel Company, Youngstown, Ohio..	61
Bethlehem Steel Company (Lackawanna Plant), Buffalo, N. Y.....	114

*Vice President, The Koppers Company.

Trumbull Cliffs Furnace Company, Warren, Ohio....	47
Diamond Alkali Company, Alkali, Ohio.....	23

By-Product Gas Oven Plants:

Battle Creek Gas Company, Battle Creek, Mich.....	11
Consumers Power Company, Zilwaukee, Mich.....	19
Winnipeg Electric Railways Co., Winnipeg, Canada..	17
Utica Gas & Electric Company, Utica, N. Y.....	21

712

The operating results from these plants and from the Weirton Steel Company's plant of 37 Becker type ovens which was completed in 1923, indicate very clearly that the Becker type oven has firmly established itself in the by-product coke oven industry. It will be noted that among the plants put into operation was a 366 oven extension for the Carnegie Steel Company at Clairton. The coke plant at Clairton was already the largest in the world. With this additional capacity, the Clairton plant now carbonizes over 22,000 tons of coal per day.

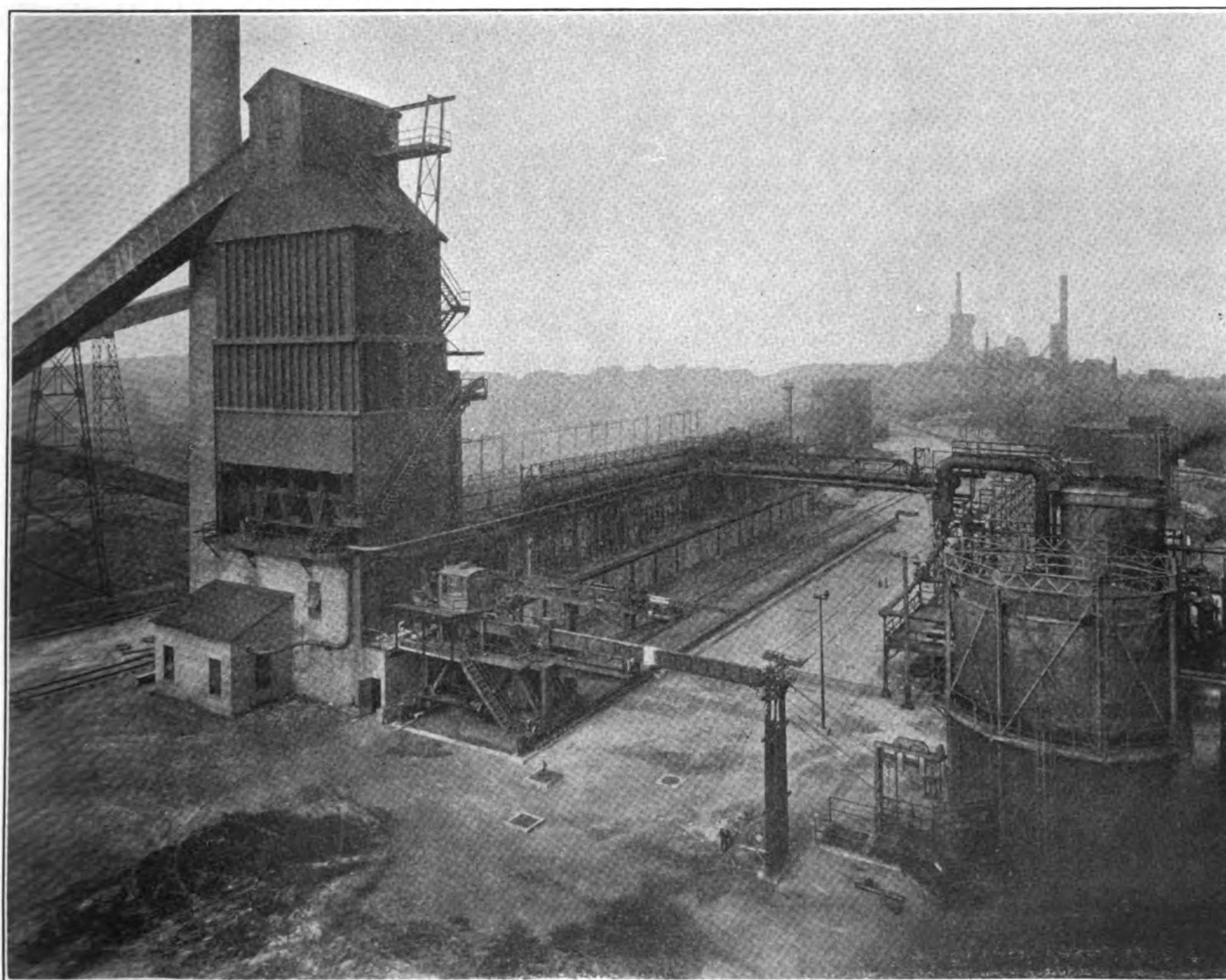


FIG. 1.—New By-product Coke Plant of the Trumbull Cliffs Furnace Company, at Warren, Ohio.

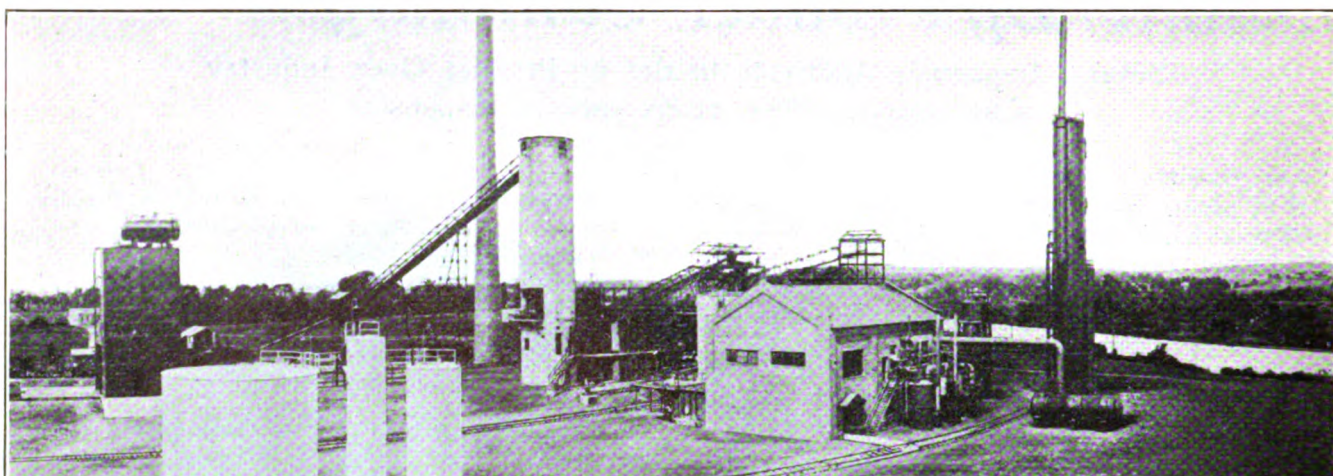


FIG. 2

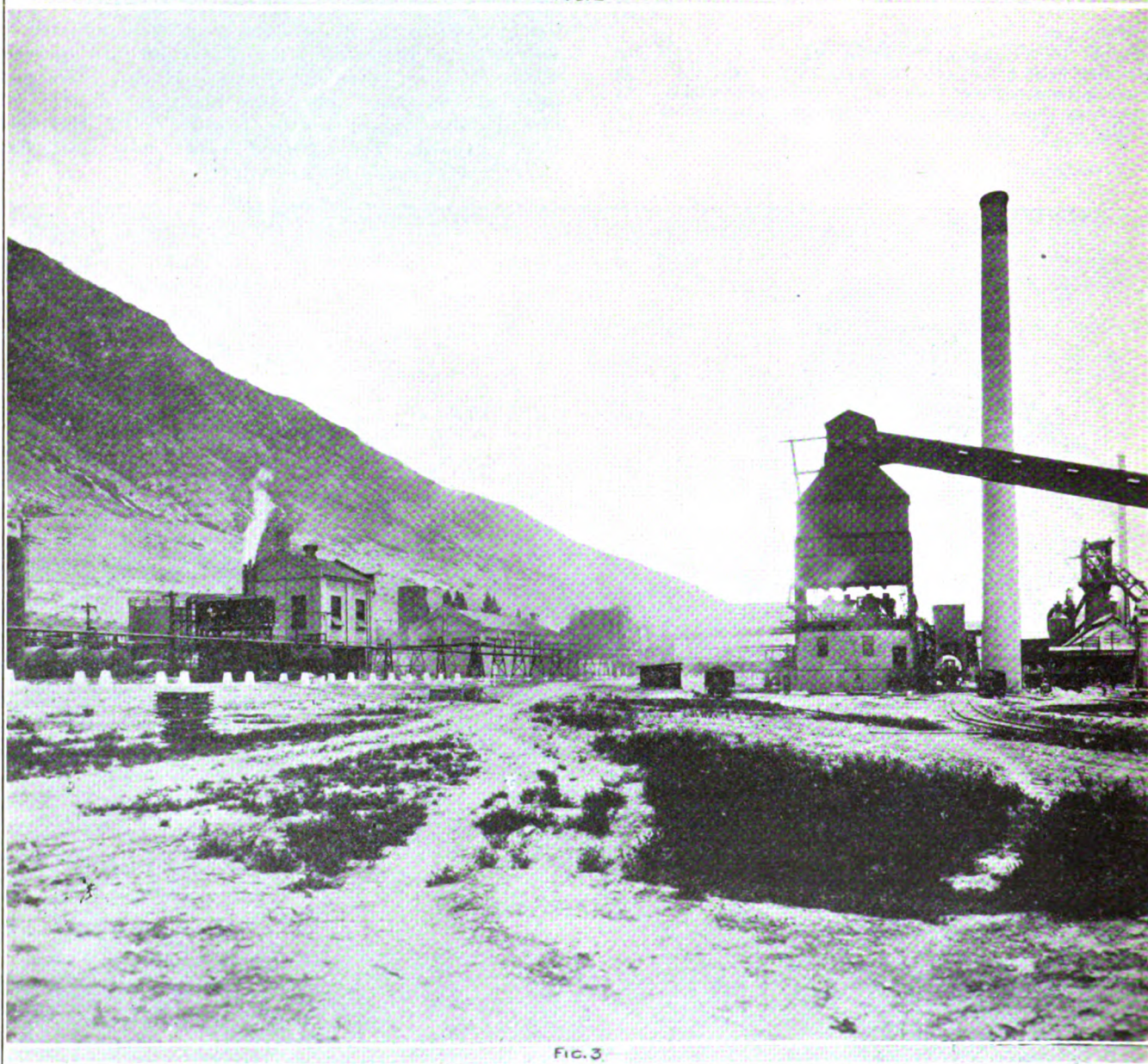


FIG. 3

FIG. 2.—View of 21-oven installation for the Utica Gas & Electric Company, Utica, N. Y.

FIG. 3.—By-product (Becker type) ovens recently put into operation at Provo, Utah, to supply coke to the blast furnace shown in the back-ground.

Another striking feature of this construction was the completion of the plant at Provo, Utah, having a daily carbonizing capacity of 1,000 tons of coal per day. This plant carbonizes the high volatile Utah coal, producing coke which is used in the blast furnace of the Columbia Steel Company at Provo, with excellent results. Heretofore, it has been considered impossible to produce a satisfactory blast furnace coke with these coals. This plant has now been in operation for over six months and the results secured to date show conclusively that a satisfactory blast furnace coke can be made from these coals in the Becker type ovens. The successful operation of this plant is a very definite step forward in the by-product coke oven practice.

Another interesting part of the 1924 construction has been the successful operation of the coal gas plants of the Becker type. It will be noted that four plants of this type were completed, all of which are operating with excellent results.

New Construction in 1924.

While the amount of new construction contracted during 1924 was not as great as during 1923, a substantial amount of work was placed. A list of the plants contracted for during 1924 is given below:

Name and Location	No. of Ovens	Type of Oven
Coke Plants:		
By-Product Coke Corp., Chicago, Ill.....	110	Becker
Republic I. & S. Co., Birmingham, Ala....	57	Becker
Illinois Steel Co., Gary, Ind.....	138	Becker
Alabama By-Products Co.....	25	Koppers
Consumers Power Co., Jackson, Mich.....	15	Becker
No. Ind. Gas & Elec. Co., Ft. Wayne, Ind..	19	Becker
Lynn Gas & Elec. Co., Lynn, Mass.....	11	Becker
Woodward Iron Co., Woodward, Ala.....	40	Koppers
Hudson Valley By-Product Co.....	44	Foundation
Total.....	459	

This shows that contracts for 459 ovens were placed, 375 of which are of the Becker type, 40 of the Koppers type and 44 of the Foundation type.

Extension Mine Rails

By Harold P. Tompkins*

The problem of track extension to keep pace with the advancing work of the miner has always been considered a serious one. It seems to have been solved in a comparatively simple and practical manner, and the patent offices of both the United States and Canada and several European countries where mining is important have recognized the novelty and validity of the idea.

The first installation was made at the Tompkins mines at Cedar Grove, W. Va. The views shown in Figs. 1 and 2 of the original patent drawings illustrate the method of construction.

Standard size samples have been manufactured at one of the steel companies' plants and are now in use in some of the largest representative mines in West Virginia and Pennsylvania. It is reported that all those operators who have tried out the device are highly pleased and it is stated that its use will greatly lower the cost of track laying in mines and will not

only bring about a saving to the operator, but will also benefit the miner in more steady employment and better earnings.

Extension rails are channel members, simple in construction and designed to fit over the ordinary rail. They are rolled with a groove in the middle for the car wheel flange to travel in, with a combination car stop and handle at the end next to the face. When the workman is ready to extend his track closer to face or point of loading, he takes hold of the handle and slides the extensions forward to the required distance and the track thus provided is ready for use. This is repeated each time a projection of track is desired, until the extensions have advanced their full length. Then the permanent track is laid with full length steel and the operation repeated. Thus, the extension is quickly made and the old systems of "jumpers," "balling-in," "inverted rails," etc., are eliminated.

Results have shown that the extension rails save to the operator the entire cost of laying down and tearing out short track projections, a cost estimated at 7 to 12 cents a ton, and probably three-fourths of all track laying expense. The indirect costs in the way of idle working places, unemployed contract labor, inefficient functioning of every day man and piece of machinery and equipment from face of coal to tippie, while that part of the mine is waiting for track under the old methods, also is saved, as well as the cost of supplies and tools required under these old methods and sometimes the taking up of bottom or brushing of top, where the seam is thin.

The miner or loader will recognize his big saving by their use, in the time lost in either waiting for his "jumpers," etc., to be laid and taken up or in laying them himself, a delay which sometimes consumes as much as a day to each miner, waiting on the track crew, materials, etc. The saving of time, of course, increases the miner's tonnage and his pay envelope.

With the Tompkin extension rail, the track can be projected and ready for use in 30 seconds by the miner himself, without expense of a track crew, without ties, spikes, bolts, clamps or supplies of any kind, without track hatchet, wrench, or tools of any kind. It is self-gauging and has a vertical crown or middle ordinate to prevent it from "kicking up" if one end is laid on the bottom while the other rests on rail and tie. It gives more head-room in low coal, permits the car to be positioned as close to the face as desired, and it can be quickly removed for the operation of tractive loading machines, a big advantage where mechanical loading is done.

The lateral strength being much greater than that of an ordinary teerail recommends it for use where arcwall cutting machines are installed, to keep a more perfect alignment and the grooves prevent the equipment from jumping. The handle acts as a safety device to prevent the car from running off the end of the track and pinning the workman against the face.

The extension rails can be used indefinitely, are simple of construction and reasonable in cost. All the patentable features are fully covered and it is believed they will come into very general use in the near future, throughout the mining fields, since they have the endorsement of some of the largest and most experienced operators.

*President, Tompkins Fuel Company, Charleston, W. Va.

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The Open-Hearth in 1924

A Resume of Results Obtained by the Application of Demonstrated Combustion Principles

By F. J. CROLIUS

THE metallurgy of the open hearth will not be considered in this article. What will be attempted is the general consideration of the open hearth furnace as a combustion unit during the past year. It seems as if we were going to have to classify open hearth furnaces from now on as we have classified boiler furnaces in the past: by dividing them into natural draft furnaces and forced draft furnaces.

The standard open hearth furnace is a natural draft furnace. The Danforth restricted furnace belongs to this type. The Egler and the McKune furnaces are forced draft furnaces and the more recent Loftus furnace is distinctly such.

Natural draft practice in boiler installations used to be strongly advocated by boiler builders. They

claimed there was no gain in efficiency by the use of forced draft and (in very extreme and prejudiced minds) they also claimed that they could show as great capacity under natural draft as could be obtained with forced draft. Both these statements need revision today. They were made because of timidity and so-called "conservatism" on the part of the boiler manufacturers, or better perhaps, because of an undeveloped art.

The fundamental reason why the old-time natural draft advocates were wrong is because gases behave differently when they are pushed, from the way they behave when they are pulled, and also because combustion resulting from forced draft can be more

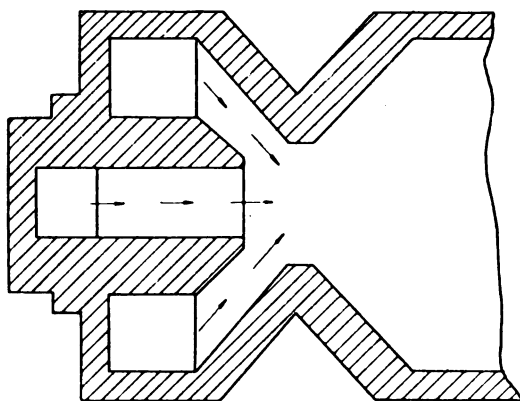


FIG. 1—Two views of the Danforth restricted throat open-hearth.

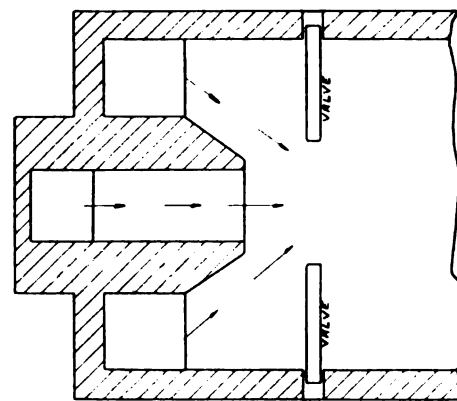


FIG. 2.—The Egler type furnace.

completely controlled as to space, time and intensity than when it results from natural draft.

When gas burning in boiler furnaces was first developed we all remember how crude were the devices employed. A pipe in a hole would describe the construction. Contrast it with the beautifully designed gas burners and oil burners now supplied to boiler furnaces. Why did this part of the engineering field demand such faithful application and development of design on the part of those charged with the work of burning oil and gas? The answer is that the burning of liquid and gaseous fuels is not a simple thing. You cannot afford to put these elements together and let nature take its course, especially in the face of diminishing gas and costly coal. The gains in efficiency have amply compensated for the labor expended on burner and furnace design.

The accepted designs of gas burners for boiler practice are those which aspirate the gas with air or steam, which conduct the aspiration along lines parallel to the resultant stream of burning gas, which utilize the atomization effect as far as possible and the combustion chamber for the development of the flame before it is finally burned to satisfied gas in the

boiler furnace itself. The best designed boiler furnace is that which feeds to the tubes of the boiler gas in the condition of most complete combustion where the gases have performed their whole function and realized the utmost possible in heat.

It is instructive to see how the inevitable development of this position has been brought about in the design of open hearth furnaces.

When McCune and Egler approached the problem of forced draft they were also brought face to face with this real problem of design and control. Both these inventors solved it (each in his own way) by the use of water-cooled valves in the furnace itself. These valves in the incoming end were closed in order to cause the incoming air to be brought into contact with the gas stream to the greatest extent possible, in order to obtain the most intimate mixture possible. The surplus air was allowed to lead past the valves in order to form a blanket of air moving at a slower speed than the gas stream and filling the space between the upper course of the stream of burning gas and the roof.

A weak spot in each of these furnaces was the water-cooled valve system. The valves gave a great

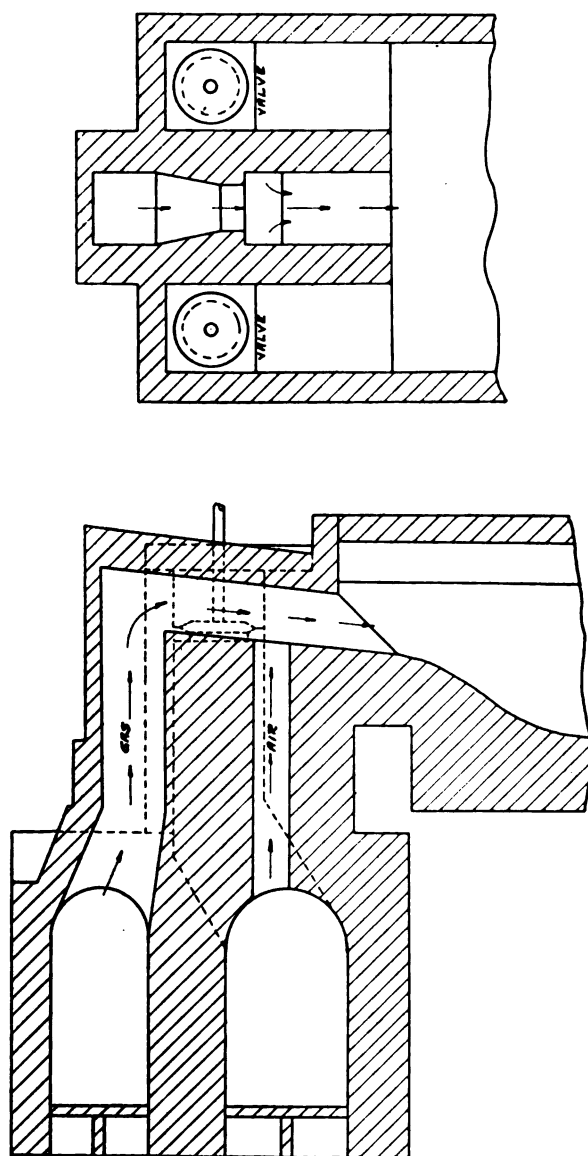


FIG. 3.—The McCune design of open-hearth.

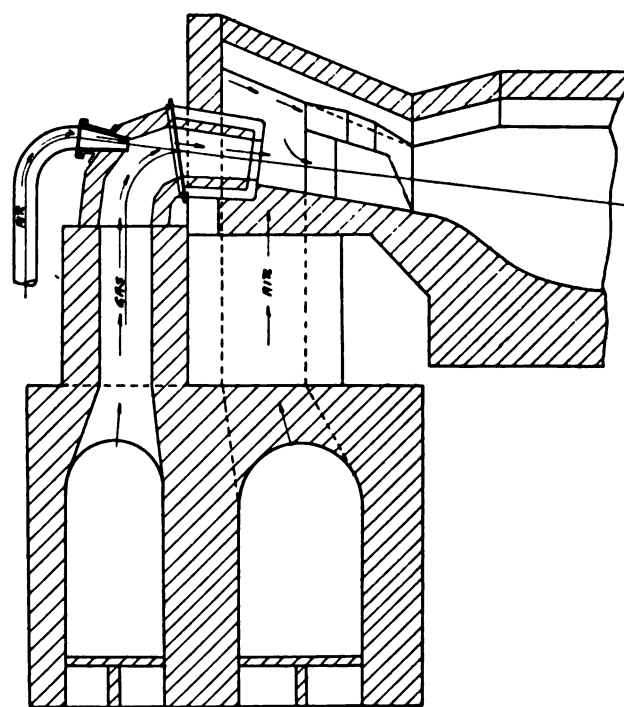
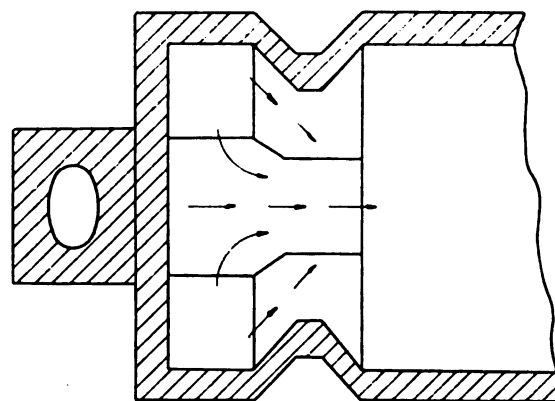


FIG. 4.—The Loftus type of furnace based on the venturi line throat principle.

deal of trouble. The deposit of scale and mud from the water used, the interruptions in actual water supply, the warping of valves and seats and the sticking of valve operating mechanism all combined to make the operation difficult and uncertain.

The successful operation of these furnaces also depends on the complete withdrawal of the valves from the flues of the outgoing end. When the valves did not function properly the furnace slowed down or there was very troublesome backlash on the furnace doors.

Another feature which failed to live up to expectations was the port and burner system. The ports were of course water-cooled and gave trouble on that account; and the burner system was not conceived in such a way as to give that intimate mixture of air and gas which should characterize the perfect flame.

When these furnaces are studied from the combustion standpoint their similarity to the early operation of gas burners under boilers stands out very clearly.

The stream of gas preheated in the checker rises in the customary way and is deflected to pass under the port. The air is forced up beneath the gas stream confined in the port and is there mingled with it as well as it can be made to do so by such a device.

Bearing in mind that the performance of all these functions occupies but a few seconds of time from the beginning of the whole operation to the supplying of the completed and developed flame at the hearth, one can readily see that the operation is essentially crude and variable, nor is it conducted in accordance with the fundamental law of gas-flame development which is that the commingled elements must be allowed to achieve a helical motion.

While it is certain that the McKune and Egler furnaces were very hot, the ideas referred to above made it certain that repairs on roof, walls and furnace ends would be high. The directing of the flame by means of the ports did not cause the stream of gas to hug the surface of the bath sufficiently to prevent the punishment of roofs and walls, and this was to a considerable extent the result of the unsatisfactory way in which the port operates as a burner.

These furnaces may be said to have lived out their day in 1924. It is believed that there is not one of either type in actual service at this moment in the entire United States.

The Danforth furnace was the child of many hopes, but the results which were expected from its concentration of gas and air streams upon a common focus have not caused the operation of open hearth natural draft furnaces to be changed in any fundamental way.

There are ideas of great value in the Danforth furnace, but these are not exactly new. There is no doubt that the bringing forward of this furnace type has stimulated general activity in natural draft furnace design, and this has been of great value.

The Loftus furnace is the latest comer in the field and has been designed evidently with a view towards the elimination of the McKune and Egler troubles. It has no valves in the furnace itself. It has no ports. It has no water service whatever within the furnace. The water service is confined to the mouth and a portion of the outer curve of the gooseneck gas conduit and these goosenecks are outside the furnace itself and are removed and replaced when they give out between the ordinary reversal of the furnace and with-

out any disturbance of its operation. The crane simply lifts the burned out gooseneck away and puts a new one in its place. This is comparatively an infrequent occurrence as goosenecks have been found in practice to last from 50 to 80 heats.

The forced draft feature is the important outstanding characteristic. The necessary hot air is withdrawn from the upper part of the checker operating on incoming air and abstracted air is reduced in temperature by a small air valve on the duct between the checker and the fan. The air under pressure from the fan at about 1,000 deg. F. is led outside the furnace and turned to a position such that the outlet from this duct is on the axis of the stream of incoming gas in the gooseneck before the gas is introduced to the furnace.

The pressure of the air aspirates the gas, combustion is set up between the central core of air and the ring of gas about it. The whole operation is typical of a true gas burner.

The speed with which the jet of gas and air travels and the oval shape of the stream have done away with the necessity for ports of any kind. The furnace ends are simply furnished with blocks so that the air for combustion additional to that passing through the burner is supplied at the proper place and under proper direction. The surplus air rises to form the air blanket between the roof and the gas stream.

These furnaces are very sharp. They melt down scrap with producer gas quite as quickly as can be done with any of the richer fuels under natural draft conditions.

The motor driving the fan which furnishes the air pressure is a variable speed motor so the volume and speed of the air for the burners are under control.

The more air introduced through the burner the shorter the flame. The reduction in air supply will place the flame at any point in the bath at the will of the operator. This again is very similar to the behavior of gas burners under boilers.

The sharp working of these furnaces give rise to a quite natural expectation that they will be hard on refractories. The rims of the furnaces, however, have shown life of roof, walls and in the campaign of the entire furnace, have left nothing to be desired. Four hundred heats have been made between rebuilding in two separate campaigns.

It is quite certain that there is a material reduction in fuel cost per ton of steel and a marked increase in tonnage. These furnaces have been systematically leading the shops in which they were operating.

Another point which seems plain is that the producers used in combination with those forced draft furnaces are giving better results than are being obtained with oil or with coke oven gas and tar in other furnaces in the same plant of same size, but operating under standard natural draft conditions.

To summarize, therefore, it would seem now to be clearly established that the forced draft furnace has come to stay because it is longer lived, costs less for repairs, makes more steel and uses less fuel than natural draft furnaces. These forced draft furnaces are thus extending to the gas produced a new lease of life.

Drawings in this article will show in a general way the difference in construction of the Danforth, McKune, Egler and Loftus furnaces. Detailed reference is unnecessary.

We are tempted to prophesy for 1925 a great advance in open hearth practice and open hearth operation. A well conditioned, flexible, controlled furnace will help the metallurgist as much as the operator. This furnace is here. The gas producer plant has features that can now be made good use of. The character of producer gas is better for certain reactions than any gas high in hydrogen will ever be. There will be quick melting of scrap, plenty of time for a proper working period. A timing of furnaces will be more accurate and regular because wise operators will allow a period of leeway so that they have a reserve of speed to draw on and thus be through a troublesome heat on schedule time. Where coke oven gas and tar, or gas alone is the indicated fuel, control and proper burner arrangements will give proportionate advantages. These furnaces will also lead their respective shops and those who have said that the ultimate has been reached (and there are many) will again have to acknowledge that there are always heights behind the foothills.

Gasless Vertical Heating Soaking Pits

It seems to be the popular idea nowadays to write something new and at same time forgetting some of the practices that through the same good work has been done in the past. So I concluded to write something about the old gasless vertical heating soaking pits that were in use when I entered the steel plants. This, with a few general remarks, may be interesting at this time.

The gasless soaking pits were built of heavy fibre brick and as far as I can remember, were about a foot deeper than the length of the ingot and some inches wider. Each pit had a separate lid to exclude atmospheric air and was served by a portable crane (at that time) which after drawing the ingot from the pits placed it on a buggy and it was conveyed to the mill by a dinky and after being bloomed down was rolled into rails and other sections. If wanted for plates, the ingot was taken to the steam hammer and after hammering to the required thickness was cut into slabs according to weight for the plate mill then re-heated and rolled into boiler, ship or other classes of plates.

During the soaking, some gas exudes from the ingot and fills the pits with a non-oxidizing atmosphere of hydrogen, nitrogen, carbonic oxide and carbonic anhydride, to the exclusion of atmospheric air, it is considered that no metal is lost by oxidation.

They claimed that this simple process with the heat distributing from the interior of the molten ingot that pipe was eliminated to a great extent. It seems to me that some types of steel, carbon treated in a similar manner, would give good results besides being a saving on fuel.

Besides my remarks on gasless soaking pits, I may be permitted to give two experiences on mill work to show that at times, good steel may be spoiled in the rolling. Mistakes in almost every trade resemble some of the miracles in the old testament—they need a little explanation to clear them up. In visiting a rolling mill a few years ago, I saw a 17x32 in. ingot alloy steel, rolled into a 6x8 in a 40 in. bloomer. They gave the ingot a flat pass for a start then kicked it up and after giving it several edging passes till it concaved, they threw it down and took it across to the bull head and flattened it out. This process was re-

peated several times which, with the extra edging work on the ingot, gave very unsatisfactory results, and still the man in charge complained about defective steel and tried to throw the blame on the open hearth, instead of the shape of the ingot.

Another example. I saw rolled in a Universal Blooming Mill a 20x22 in. alloy steel, rolled into a 6x8 bloom. They rolled it down to a 9½x14½ in., 9½ in. with the screw down and 14½ in. with vertical, then kicked it up and took the 1½ off with vertical rolls and the 8½ per horizontal rolls. The ingot only being kicked up once and all this time on account of their steam spray being weak they had to contend with the surplus scale, salt and water, lime, etc., combined left the surface of the bloom all roughed up, necessitating extra chipping and extra scrap. Then we saw on some finished blooms an overlap extending from end to end of bloom on two opposite corners and as usual the old complaint, defective steel, was blamed for this. The cause of the overlap was that the ingot had not been uniformly heated and during the rolling down to a 9½ the hot side yielded more than the colder side and when the piece was kicked up the overlap was rolled in and remained there till chipped off.

Instances similar to those already given could be multiplied to show that defective heating is the cause of great loss both in the rolling and in the finished product. It seems to me that with the gasless soaking pits properly heated and the ingots properly timed when charged into the pits, good results would follow, and a great saving of fuel would also be effected as already stated.

In the old days the heater worked from his own judgment and calculations, and on that account was not always successful, but with the up-to-date scientific appliances we now have and with a constant supply of hot ingots we should be able to obtain good results with at least carbon steel and perhaps some classes of alloys.

This is written with the view of creating some discussion on this subject and obtaining the opinions and experiences of others.

Obituary

L. Leslie Helmer, general manager of the Cumberland, Md., works of N. & G. Taylor Company, Philadelphia, manufacturers of tin plate, died of typhoid fever at his residence on December 24, aged 47 years.

Born at Terre Haute, Ind., he received his early education at the Terre Haute High School and was graduated at the Rose Polytechnic Institute in 1901. After a short employment with the Pittsburgh Testing Laboratories, he was engaged early in 1902 as night chemist in the open hearth department of the Taylor plant. In 1903 he was made superintendent of the black plate department and in 1916 was appointed general manager. He was elected to the board of directors of the Taylor Company in 1917 and at the same time was given the title of assistant secretary-treasurer.

John M. Read, formerly assistant general manager, has been appointed general manager of the N. & G. Taylor Company works at Cumberland, Md., succeeding the late L. Leslie Helmer. Mr. Read has been identified closely with the management of the plant for the past 15 years.

Pulverized Fired Malleable Furnaces

Search for Closer Economies has Focused Attention
Upon Regenerators

By SIGUARD WESTBERG*

FUEL costs are always a chief concern in the production of malleable castings. Whether the fuel be gas from producers, fuel oil or coal fired by hand, on stokers or through a modern pulverizing system, the problem of high exit temperatures must be accepted as a condition.

The waste-heat boiler has been a natural first expedient, and with considerable success where surrounding conditions warranted the expense involved, and the steam generated could be advantageously utilized. Usually, however, more steam is generated than is necessary in the average malleable plant, especially when the furnace is melting at its peak rate, while the efficiency of the boiler suffers due to the lack of uniformity in temperatures leaving the furnace

have come to accept pulverized coal firing as a means of greatly lessening operating cost by increased production, and releasing labor for more useful work as well as the ability to get results, when firing coal of inferior quality, in case of emergency if called upon to do so, as in case of abnormal trade conditions.

Some 30 companies involving over 100 melting and several hundred annealing furnaces are operating with pulverized coal or making installations of pulverized coal equipment. This represents a most substantial and important progress of pulverized coal fuel in the metallurgical industry during the passed six years.

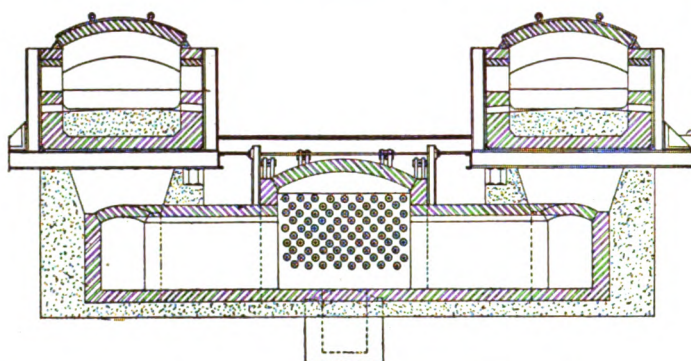


FIG. 1.—Two views of a recently designed malleable melting unit, showing the possible combination of a single set of carborundum recuperators with two furnaces.

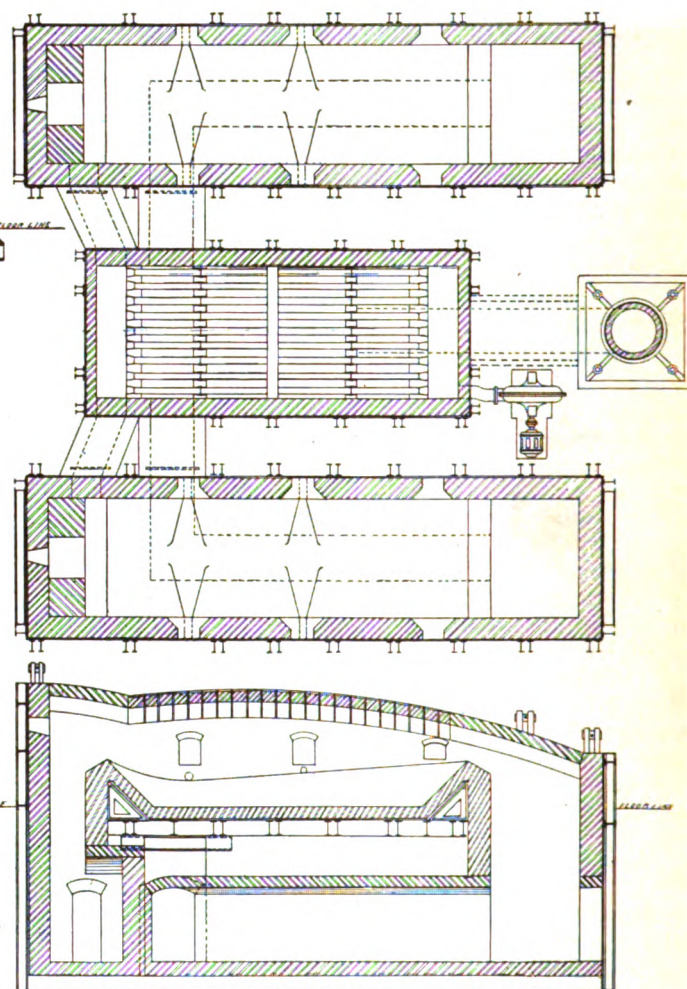
during the cycle of the operation. It is not practical to constantly maintain exit temperatures of 2,000 deg. or higher under which condition the waste heat boiler can operate with economy.

The furnaces used for melting iron are practically all of one design—non-regenerative. Many of these have been converted from other fuels to pulverized firing.

The only important change in the design of the melting furnace to burn pulverized coal has been the elimination of the grate bars, and top blast, used in hand firing. These were soon found to be unnecessary as the front bridge wall burned out immediately, and all of the air for combustion was satisfactorily mixed with the coal in the burners. Melting furnaces using atmospheric temperature air for combustion produces satisfactory results so far as time of heats and fuel consumption is concerned—regularity of time of heats—kinds of coal, that can be used in emergency, etc. Results obtained by equipping existing furnaces with slight modifications, for pulverized coal as a fuel justify interest in means for improvements, in operating economies, such as fuel, which is now the most important factor.

Practically all malleable casting manufacturers

*Consulting Metallurgist, Pittsburgh, Pa.



The noticeable tendency toward the employment of pulverized coal with correspondingly forced furnaces, emphasizes the need of some form of heat recovery other than the boiler. Regenerators or recuperators appear to offer the most practical solution.

The maximum speed of heating, or a reduction in the time required to bring a malleable annealing furnace charge up to temperature is an important operating economy. Pulverized coal firing accomplishes this. About one-third coal is required when pulverized. Where pulverized soft coal is substituted for hard

coal or fuel oil the savings are further increased due to the lower first cost of the coal. Oxidation reduced to the minimum due to provision being made for the proper mixture of carbon and oxygen. The importance of oxidation of the iron and its constituents is sometimes overshadowed by the stress laid on increased tonnage production and decreased fuel consumption. The application of the pulverized coal firing with preheated air changes the whole characteristics of the melting process, as the ratio of what may be termed the melting power to the oxidation power of the flame will be altered in the right direction.

The higher temperatures attainable with pulverized coal and preheated air with the resulting high temperature radiation and shortened time element will account for the higher melting power or driving rate, and this shortened time element with the lessened excess of air or free oxygen results in lower oxidation losses. By decreasing the time of a cycle the capacity of the furnace is correspondingly increased.

Where only a small heat is made daily, the investment for regenerators may not be warranted, while in the case of a furnace making two heats a day, or say 30 tons of castings per furnace, per day a regenerator that would not be too expensive in first cost, and proved practical under operating conditions should be an attractive consideration. Where two furnaces are used alternately one regenerator placed between the furnaces may be the solution, see Fig. 1. In a few cases where continuous operation is the practice, the greatest benefits are to be obtained, and obviously each furnace would be equipped with a regenerator.

The question of the type of recuperator, and the material employed in its construction here becomes important. Carborundum by its very nature, has been shown to be ideal for such purpose, as it withstands oxidation admirably, while its heat absorption and transfer factors are exceptional.

As a great many malleable foundries are operating two furnaces without waste heat boilers, and making two heats a day with an average cast of 15 tons per heat, or 30 tons a day where pulverized coal is used, this condition may be accepted as the average. Taking first the efficiency of the furnace operating 10 to 12 hours a day, the rate of heat transfer in the carborundum regenerator is several times that found in regenerators of the same size, when made of fire clay blocks or tiles. When this type regenerator is thoroughly heated it will retain its temperature a number of hours, if the stack damper is closed during the night period when the furnace is not fired.

In designing a regenerator, the flame temperature and the melting point of the ash are most important considerations; where 2,000-2,400 deg. temperatures are involved, the tubes of the regenerator must not be exposed to ash in the plastic form. By referring to Fig. 1, it will be seen that the hot gases are obliged to traverse almost the length of the regenerator chamber before entering the latter, the purpose of this being to insure the precipitation of all heavy particles of ash before delivering the gases to the regenerator tubes, at the same time providing means for the easy removal of ash, in either molten or powdered form. In the event of any powdered ash being precipitated on the tubes in the regenerator chamber, its removal is treated in the same manner as tubes in a steam boiler.

New Controls for Science and Industry

When a machine is to be built, its size and shape are controlled by the dimensions on the designer's drawings or in the specifications. But it is usually necessary to control other features also by stipulating the tensile and crushing strength, the hardness, the weight per cubic inch and other qualities of the materials to be used. In other kinds of work other kinds of controls become necessary depending upon the purposes to be accomplished and the properties or limitations which determine success.

The definite melting points, solubilities, fluidities and boiling points of pure chemical substances have furnished controls of inestimable value in the development of chemistry. Colloids (matter in jelly-like, uncrystalline condition) do not possess definite melting-points, solubilities, fluidities, and similar qualities. Hence there can scarcely be any doubt but that the discovery of controls similar to those used in classical chemistry would mean much to the newer science. This is all the more true since colloid chemistry is involved in so many industries, of which we merely cite ceramics, metallurgy, plastic, road building, paint, varnish, and rubber.

Such controls may be obtained through the development of the new science of the flow of matter, fluidity and plasticity. It is a curious fact that the flow of electricity, which we cannot see, is so much better understood than the flow of readily visible substances, such as the soft solids—for example, the "clay slip" of the pottery manufacturer. The reason appears to be that electricity in wires is carried by one thing only, electrons, whereas in the flow of matter molecules are involved and they possess infinite variety. But this condition which appears at first to be a disadvantage may eventually be turned to account, for the character of the flow may be utilized to give important information about the sizes of the molecules.

As a liquid is compressed either by pressure or by cooling, its volume V approaches a limiting volume W at which the fluidity would be zero. It appears probable that when a liquid occupied the limiting volume, the molecules would touch one another.

The fluidity of a liquid originates not in the molecules themselves, but in the spaces between them, defined by the difference of volume, $V-W$. It is found that the fluidity is directly proportional to the free volume $V-W$. Since it is easy to measure both the fluidity and the molecular volume, it is easy to calculate the total volume of the molecules at their limiting volume. This is perhaps the most important possible use for fluidity measurements since it opens the way to measuring not only the size of the molecules, but also those elusive chemical changes which take place on hydration, as when sugar dissolves in water.

It is known that clay differs from pitch in that a certain force is required before clay can be deformed continuously. This force, or shearing stress, is known as the yield value. The rate at which the material is deformed by forces above the yield value determines the mobility, the ease of change of form.

These properties are fundamental properties of all solids and determine the plasticity, hardness, malle-

(Continued on page 48)

Contributed by Eugene C. Bingham, director of the Gayley Chemical and Metallurgical Laboratory, Lafayette College, Easton, Pa.

The "Apex" CO₂ Indicator

A new boiler room instrument, known as the "Apex" pneumatic CO₂ indicator, has been developed primarily to meet the demand from the smaller steam power and heating plants for a simple and inexpensive instrument for measuring the fuel wasted up the chimney.

The manufacturer claims that the "Apex" CO₂ indicator will operate accurately with about five minutes' attention once a week. The price is less than half that of other CO₂ indicators, including the standard Uehling "Model U" machine. It is stated that this investment is generally warranted for steam boilers even as small as 50 horsepower, in view of the fuel savings that can be expected through the intelligent use of a reliable CO₂ indicator.

The "Apex" CO₂ indicator consists of two principal parts, namely the actuating device, known as the CO₂ meter, and the gauge proper, known as the "Type Z" indicator. The flue gas flows through the CO₂ meter continuously, developing a changing pneumatic pressure within it, the magnitude of the pneumatic changes depending upon the percentage of CO₂ present in the gas. The CO₂ is absorbed in a dry cartridge placed in the CO₂ meter. The absorption of CO₂ causes a shrinkage of the gas flowing through the CO₂ meter and hence a reduction in the pneumatic pressure. Any given percentage of CO₂ in the gas will produce a definite predetermined pneumatic pressure, which is employed for operating the Type Z indicator. The indicator consists simply of a manometer containing a glass tube filled with colored liquid, which changes its level according to the pneumatic pressure applied to it. A scale located beside the indicating manometer is graduated in percentages of CO₂.

A simple steam or water aspirator is used to draw the gas from the boiler, through the meter. A large volume of gas is bypassed around the meter at the same time, under the action of the aspirator, which results in speedy response to change in furnace conditions.

The suction from the aspirator is maintained constant, by a simple hydrostatic regulator regardless of possible aspirator pulsations. This regulator is simply a closed vessel filled with water, the space above which is connected with the aspirator. An air inlet pipe extends into the water to a point near the bottom of the vessel and is so arranged that air may be drawn in through the bottom of this pipe and caused to bubble up through the water under the effect of the suction above the water. This bubbling air automatically prevents the suction from increasing beyond the point for which the regulator is designed. The water level in this regulator is kept constant by a fixed overflow. A similar hydrostatic regulator, placed in the inlet bypass, previously mentioned, likewise acts to hold the suction on the inlet side of the machine constant, irrespective of any variations in the chimney draft.

In entering the CO₂ meter, under an unvarying inlet suction, the gas first passes through a constricted passage, then through the dry absorbent cartridge and then emerges through a second constricted passage, escaping under the constant exhaust suction, previously mentioned. Each of the two constrictions consists of a tube of definite length and bore, which acts as a fixed resistance to the flow of gas. There is no resistance in the absorbent cartridge, the gas flow-

ing freely through it at all times. These cartridges are each guaranteed for a life of 1200 per cent hours and are easily renewable when used up. The pneumatic pressure existing between the two constrictions is at all times below atmospheric pressure and as the percentage of CO₂ increases the pneumatic pressure decreases correspondingly over a wide range because of gas shrinkage due to absorption. The Z indicator is connected to the absorption chamber by means of small bore tubing and it instantly responds to all fluctuations in the pneumatic pressure. A point of particular interest is that at no time is the gas hermetically sealed in the CO₂ meter. This fact makes it always possible for the indicator to point to the percentage of CO₂ existing in the meter at the moment.

Because of the simple pneumatic principle employed, the design is entirely devoid of mechanically operated parts, special glassware and rubber tubing. Referring to the illustration of the CO₂ meter, the chamber on the left contains the dry absorbent cartridge and the constricted passage for the outflowing gas. The vessel on the right is the inlet gas regulator. The gas from the boiler enters through the vertical pipe at the top of the instrument and flows into the small chamber adjoining it which contains the inlet constricted passage. The horizontal pipe extending to the left is the outlet which conducts the gas to the outlet regulator and aspirator. The latter two parts are not illustrated here.

The "Apex" CO₂ indicator employs the "Pyroporus" filter, which is placed on the end of the sampling line within the boiler setting and completely excludes soot and ash. Another important claim for the "Apex" instrument is the elimination of sulphuric acid fog from the gas and the complete drying of the gas which prevents corrosion of the sampling line.

The "Apex" CO₂ indicator is being manufactured by the Uehling Instrument Company of Paterson, N. J. A corresponding instrument of the recording type is also being introduced by the same company. Both types are illustrated in Uehling Bulletin No. 118.

New Controls for Science and Industry

(Continued from page 47)

ability, shortness and the like. Pitch, previously mentioned, is not a solid at all, but a very viscous liquid. It may be so brittle that it will fly to pieces when struck with a hammer, yet there is no minimum shearing stress which is required to deform it continuously. For this reason pitch will not hold a shape given to it, but will flow under very small stresses such as arise from gravity when long continued.

An example of the need for plasticity controls may be cited. The American Society for Testing Materials some years ago conducted a test on 240 samples of paint, using a test fence at Arlington, Virginia. To give the paints a fair test all were made up to have the same apparent viscosity, but some of the paints flowed, carrying the pigment down and leaving bare spots. In the light of recent knowledge it appears that the paints should not all have had the same viscosity, but it appears probable that they should all have been made up to have the same yield value, in which case all of the paints would have formed a coating on their respective panels.—Research Narratives.

The POWER PLANT

Power in the Iron and Steel Industry in 1924

By BARTON R. SHOVER*

VAST changes have taken place within a decade in the attitude of iron and steel producers toward power. Originally, power was an incident in the scheme of production. Coke was made in the simplest ovens, and the most valuable part of the original coal was allowed to escape to pollute the surrounding atmosphere; blast-furnace bleeders had more relation to furnace pressure and stove requirements than to total heat balance; open-hearths were considered and operated entirely from the metallurgical viewpoint without consideration of their potential part in a great total scheme; boilers burned coal, and men shoveled it.

The underlying factors which have changed all this are too essential and now too thoroughly understood to bear discussion.

An outstanding feature of 1924 was the World Power Conference in London. In assembling the material for the first authentic survey of conditions within the steel industry in America, for official presentation before this international body, Mr. Shover developed data and conclusions which form a text for the industry. Much of the material contained in the report has been published under various covers, in the *Iron & Steel Engineer*, *Iron Trade Review* among others. So important is the contribution as a reference medium for every day practice that it seems fitting to reproduce many details hitherto unpublished.

The following figures, taken from the Statistical Report of the American Iron & Steel Institute for 1922 upon which the power estimates are based, will impress even the uninitiated with the importance and amount of power required by this industry.

TABLE I.

	Production Net Tons*	Capacity
By product coke.....	28,550,545	
Other coke	8,573,467	
Total	37,124,012	
	Gross Tons	Gross Tons
Pig Iron	27,219,904	52,686,820
Ingots	34,568,418	58,644,655

*Consulting Engineer, Fellow, A. I. E. E.; Member, American Iron & Steel Institute; Past President, Association of Iron and Steel Electrical Engineers, Pittsburgh, Pa.

*"Net ton" is 2,000 lbs. unless otherwise specified. "Tons" means, 2,240 lbs.

Rolled Products

	Tons
Rails	2,171,776
Plates	3,419,920
Sheets	4,548,477
Nail and spike bar.....	21,969
Wire rods	2,654,741
Structural shapes	2,718,768
Merchant bars	4,554,474
Skelp	2,859,095
Hoops	222,139
Bands and cotton ties.....	271,101
Splice and tie plate bars.....	605,688
Sheet piling	13,220
Railroad ties	14,811
Forging blooms	326,303
Blooms, sheet bar, etc., exported.....	11,299
All other rolled products.....	2,038,223
Total	26,452,004

Average and maximum productions for the 10 years 1913 to 1922.

Averages.

	Net Tons
Coke	44,699,261
Pig iron	31,317,464
Ingots	34,082,495
Rolled products	26,228,363

Maximum.

Coke —	net tons	1918		56,478,373
Pig iron —	tons	1916		39,434,797
Ingots —	tons	1917		43,619,200
Rolled products —	tons	1917		33,067,700

It is very difficult to secure accurate information on power conditions in the steel industry, as many concerns think that secrecy should be maintained on all matters pertaining to steel production, while others feel that the good to be derived is not worth the trouble involved.

However, many companies were willing to furnish figures not involving their actual detail cost, as shown by the data collected for the Association of Iron & Steel Electrical Engineers and the Carnegie Institute of Technology, and upon this information are based conclusions which although perhaps not absolutely accurate, can be taken in general as correct for the entire industry.

The Association of Iron and Steel Electrical Engineers has published charts entitled "Power Charts" and "Cost and Practice Chart", containing data while more or less theoretical, has in every instance been checked against actual practice. Applying them to the 1922 production of coke, pig iron, ingots and blooms, assuming that all coke is made in by-product

TABLE IV. — BLAST FURNACES

	Number of Power Units				Rated Horse Power			
	1909	1919	% Change Inc.	% Change Dec.	1909	1919	% Change Inc.	% Change Dec.
Number establishments	208	195	...	6				
Tons produced	25,651,798	30,543,167	19	...				
Plant Power								
Steam	2,568	2,300	...	10	1,033,033	1,249,817	21	...
Internal combustion	60	137	128	...	125,230	283,015	126	...
Water	12	10	...	17	309	371	20	...
Total	2,640	2,447	...	7	1,158,572	1,533,203		
Purchased Power								
Electric	453	1,004	121	...	14,850	48,204	225	...
Other	...	...	...	...	...	25	...	...
Total	453	1,004	121	...	14,850	48,229	225	...
Total Primary Power.....	3,093	3,451	11	...	1,173,422	1,581,432	35	...
Electric from Plant Power.....	3,009	6,446	114	...	120,293	194,350	62	...
Total Electric	3,462	7,450	115	...	135,143	242,554	79	...

ovens and all power except for blowing the blast furnaces is applied electrically, gives the following:

TABLE III.

	Power Required. K. W. Hrs.	Cost
Coke	111,372,036	\$1,484,960.48
Pig Iron	435,518,564	3,266,388.48
Ingots	241,078,926	2,074,105.08
Blooms	790,925,408	6,692,445.76
Totals	1,479,794,934	\$13,517,899.80
13,517,899.80	= \$0.091 per K. W. Hr.	
1,479,794,934		

This cost per kwh. is a little higher than the average cost of power generated by steel works and a little lower than the average cost of purchased power, so it would appear that either the power requirements were a little low or costs a little high for the entire industry.

The last complete report of the United States Bureau of Census, which is for 1919, gives much interesting and valuable data in regard to this industry, and while it is to be regretted that later figures are not available, a comparison of those for 1919 with corresponding figures for 1909 gives an indication of the tendencies and some idea of present conditions. From these figures the following tables have been prepared.

TABLE V. — FERRO ALLOYS

Comparison of Rated Horse Power Installed	
Plant Power	
Steam	1919
Internal combustion	34,420
Water	88
Total	34,508
Purchased Power	
Electric	4,579
Total Primary Power.....	37,087
Electric from Plant Power.....	19,456
Total Electric	24,035

Data for Ferro Alloys for 1909 was included with Blast Furnaces.

In these tables, "Number of Units" represents the number of engines or motors installed. "Rated Horse Power" represents the total rated horsepower of the units irrespective of the amount of power, or h.p. hours generated or used. "Other Power" is chiefly from line shafting extended from adjacent works.

Power Generation.

Tables IV to IX show that "Water" and "Other Power" are not used in sufficient amounts to be given consideration, and that practically all "Primary Power" generated in the plants comes either from steam or internal combustion engines.

TABLE VI. — STEEL WORKS AND ROLLING MILLS

	Plants Having Both Steel Works and Rolling Mills				Rated Horse Power			
	1909	1919	% Change Inc.	% Change Dec.	1909	1919	% Change Inc.	% Change Dec.
Number establishments	446	500	12	...				
Tons produced	26,723,274	36,211,947	36	...				
Plant Power								
Steam	5,896	5,418	...	8	1,956,846	2,856,556	45	...
Internal combustion	118	141	19	...	79,391	257,473	224	...
Water	50	33	...	3	5,829	9,041	55	...
Total	6,033	5,592	...	7	2,042,066	3,123,070	53	...
Purchased Power								
Electric	2,211	22,053	897	...	58,797	695,097	1,082	...
Other	...	...	...	...	115	2,750	2,291	...
Total	2,211	22,053	...	...	58,912	697,847	1,085	...
Total Primary Power.....	8,244	27,645	235	...	2,100,978	3,820,917	82	...
Electric from Plant Power.....	25,558	63,437	148	...	657,812	1,655,499	150	...
Total Electric	27,769	85,480	208	...	716,609	2,350,596	228	...

TABLE VII. — TIN AND TERNE PLATE
Works Not Connected With Steel Works or Rolling Mills

	Number of Power Units				Rated Horse Power			
	1909	1919	% Change Inc. Dec.		1909	1919	% Change Inc. Dec.	
Number establishments	...	23	...	..				
Tons produced	660,536	1,315,399	99	..				
Plant Power								
Steam	27	30	11	..	7,937	17,429	120	...
Internal combustion	2	1	...	50	200	8		96
Total	29	31	7	..	8,137	17,437	114	...
Purchased Power								
Electric	3	145	4,733	..	17	1,260	7,306	...
Total Primary Power.....	32	176	450	..	8,154	18,697	129	...
Electric from Plant Power.....	99	436	340	..	1,130	7,683	580	...
Total Electric	102	581	470	..	1,147	8,943	680	...

TABLE VIII. — WIRE DRAWING PLANTS
Plants Not Connected With Steel Works or Rolling Mills

	Number of Power Units				Rated Horse Power			
	1909	1919	% Change Inc. Dec.		1909	1919	% Change Inc. Dec.	
Number establishments	56	66	18	..				
Tons produced	...	1,001,879	..	..				
Plant Power								
Steam	268	129	...	52	63,516	61,666	...	4
Internal combustion	28	8	...	71	3,256	1,966	...	40
Water	19	10	...	47	2,151	639	...	70
Total	315	147	...	53	68,923	64,271	...	7
Purchased Power								
Electric	128	2,148	1,578	..	3,031	55,030	1,715	..
Other	...	150	...	..	5	150	2,900	..
Total	128	2,298	1,695	..	3,036	55,180	1,718	..
Total Primary Power.....	443	2,445	452	..	71,959	119,451	66	..
Electric from Plant Power.....	891	1,181	33	..	15,793	31,616	100	..
Total electric	1,019	3,329	227	..	18,824	86,646	376	..

TABLE IX. — SUMMARY

	Number of Power Units				Rated Horse Power			
	1909	1919	% Change Inc. Dec.		1909	1919	% Change Inc. Dec.	
Number establishments	710	784	10.42	...				
Plant Power								
Steam	8,728	7,877	...	10	3,061,332	4,217,888	38	...
Internal combustion	208	287	38	...	208,077	542,550	161	...
Water	81	53	...	35	8,289	10,051	21	...
Total	9,017	8,217	...	9	3,277,698	4,770,489	46	...
Purchased Power								
Electric	2,795	25,350	807	...	76,695	804,170	949	...
Other	...	150	...	...	120	2,925	2,337	...
Total	2,795	25,500	812	...	76,815	807,095	951	...
Total Primary Power.....	11,812	33,717	110	110	3,354,513	5,577,584	66	...
Electric from Plant Power.....	29,557	71,490	185	...	795,028	1,908,604	140	...
Total electric	29,557	71,490	206	...	871,723	2,712,774	211	...
Used Direct	...	...	...	...	2,804,975	3,636,633	30	...
Total Applied Power.....	...	...	...	...	3,676,698	6,349,407	46	...
Per Cent Electric to Applied....	...	...	...	...	24	42	80	...
Per Cent Direct to Applied.....	...	...	...	...	76	57	...	25

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While reciprocating engines still comprise the larger proportion of power units, the turbine is coming more and more into use. In 1909, the turbine was not considered of enough importance to be listed separately in the census report, but the 1919 report gives 955 units aggregating 893,884 hp. or 21 per cent of the total steam power listed. Two manufacturers of turbo-generators report records of 334 units of their make ranging in size from 300 kw. to 17,000 kw. and totaling 908,425 kw. as being in use in the iron and steel industry at the end of 1923. Of these units 66, totaling 357,375 kw. or 39 per cent, have been installed since 1918.

The 160 per cent increase in the capacity of internal combustion engines shown in Table IX would, alone, indicate a very radical tendency in that direction, but conditions have changed. The years 1905 to 1914 might be termed the "Gas Engine Era" in the development of steel works power, since the major portion of the total capacity was installed during that period. In 1919, there were 287 gas engines totaling 543,462 hp. or 61 per cent of the capacity of the turbines and only 11 per cent of the total plant power.

Increase in speed, capacity and efficiency of the turbine together with its lessening cost per hp. have swung the tendency towards it, and close inquiry shows the installation of only five gas engine generating units aggregating 21,140 kw. capacity with no blowing units since 1918. This capacity compared with the 357,375 kw. turbo-generators previously mentioned as having been installed during the same period clearly shows which method of power generation is at present preferred. The advantage which the internal combustion engine has in regard to heat efficiency will probably bring it into favor again when fuel has advanced a certain amount in cost, apparently to about \$10.00 per ton, particularly if the installation cost can be reduced and reliability increased, but until they occur the gas engine is not likely to be restored to favor in America.

It will be noted from Table IX that while the increase in the total capacity of motors operated from plant power was 1,113,576 hp. or 140 per cent, the increase in capacity of motors operated from purchased power was 737,475 hp. or 948 per cent. The increase in capacity of motors operated from purchased power being so nearly equal to that of motors operated from plant power shows that purchased power must be considered as part of the power system, and this is further greatly emphasized by the difference in the rates of increase, indicating the tendency to depend more and more on electric power generated outside the works, principally by public service companies.

An illustration is the case of one large plant now purchasing considerable power, which has recently made a 10-year contract with a public service company to furnish power for replacing 12 mill engines, which change will completely electrify the plant with the exception of two mills. Of the establishments summarized under "B" in Table VII, 12 having an output in 1923 of 483, 141 tons of rolled product, purchased their entire power requirements, 16 with a total capacity of 2,883,400 purchased no power, while the remainder representing a capacity of 25,783,544 tons both generated and purchased power. For the entire list there was reported 2,033,854,655 kwh. generated by the various plants and 426,105,990 kwh., or over 17 per cent of the total as purchased power.

TABLE I shows that while some by-product fuel and waste heat is used for power generation, a larger quantity of coal is consumed. That there is more than sufficient heat available for power alone in plants having coke ovens and blast furnaces is shown in the following calculations. These figures are general and some assumptions were necessary, but they are believed to be fair, also figures used for power requirements, efficiencies, etc., taken from the Association of Iron & Steel Electrical Engineers' Charts are averages from actual practice, and the whole picture together with the deductions shows the possibilities of saving immense amounts of coal.

Assume that all power, except for blowing the blast furnaces, is applied electrically, that all steel is made in open hearth furnaces, and that all coke is made in by-product ovens. The tonnage of coke, pig, etc., are the United States production for 1922.

POWER REQUIREMENTS

	(Net) Tons	K.W.Hrs.
Coke	37,124,012	111,372,036
Pig Iron	27,219,904	435,518,564
Ingots	34,568,418	241,978,926
Blooms	30,420,208	790,925,408
Billets	11,432,041	354,393,271
Sheet Bar	5,228,131	245,722,198
Finished Steel	26,452,004	2,359,293,524
Total		4,439,203,927
Call it		4,440,000,000

Above figures are for power delivered to the motors. A.c. power is transmitted direct or by long distance high tension lines with step-up and step-down transformers, and some of it is converted to d.c. Some power is generated and delivered as d.c.

Coal Required for Process — Ingots.

$$\begin{array}{l} \text{Coal per ton of ingots, 625 lbs.} \\ 34,568,418 \times 625 \\ \hline 2240 \end{array} = 9,644,589 \text{ tons.}$$

Heating.

All ingots are bloomed or slabbed, some of the blooms and slabs are rolled direct, the remainder being reheated.

Coal per ton of blooms, 160 lbs.

Blooms (from ingot production at 88 per cent yield), 30,420,208 tons.

$$\begin{array}{l} 30,420,208 \times 160 \\ \hline 2240 \end{array} = 2,172,871 \text{ tons.}$$

Coal per ton for blooms, etc., reheated, 200 lbs.

Finished product from reheated steel, 9,945,876 tons.

$$\begin{array}{l} 9,945,876 \times 200 \\ \hline 2240 \end{array} = 888,025 \text{ tons.}$$

By-Product Fuel Available — Coke Ovens.

	B.T.U.
Surplus gas (debenzolized) 10,000 cu. ft. at 540	5,400,000
Tar, 16 gal. at 160,000	2,560,000
Braze and fines, 240 lbs. at 11,000	2,640,000

Total per net ton of coke produced... 10,600,000
Equivalent in 13,500 b.t.u. coal — tons .35

Blast Furnaces.

Surplus gas (after taking out gas for stoves and blowing engines) per ton of pig — cu. ft.....	89,000
B.t.u. value	100
B.t.u. per ton of pig.....	8,900,000
Equivalent in 13,500 b.t.u. coal — tons	.29

Waste Heat Boilers — Open Hearth.

Boiler h.p. hour per ton of ingots.....	39
Coal per boiler h.p. hour $\frac{33,479}{.75 \times 13,500}$	
= lbs.	3.3
3.3×39 =; tons.....	.057
2240	

Rolling Mills.

While there is some waste heat in the gases from soaking pits and heating furnaces, the modern tendency is towards more economical heating rather than in attempting to make use of the waste heat.

Total waste heat in coal equivalent, for 1922 production:

		Tons
Coke	$37,124,012 \times .35$	12,993,404
Pig	$27,219,904 \times .29$	7,893,772
Ingots	$34,568,418 \times .057$	1,970,400
Total coal equivalent of waste heat.....		22,857,576
Total steel requirements.....		16,705,485
Excess		6,152,091

"Mineral Resources" for 1921 states that in average years 106,250,000 tons of coal are required for the iron and steel industry, which is over twice the theoretical requirements, not to count the equivalent of over 6,000,000 tons in this form of excess waste heat. This excess coal alone amounts to the entire estimated consumption for domestic purposes.

While reasonable excuse can hardly be offered for the waste of fuel for power purposes, the theoretical figures showing an excess of waste heat for all purposes cannot be realized in practice.

Some coke ovens are not located in proximity to steel works, so sell their surplus gas for domestic purposes, and since a portion of the tar and sometimes the gas also can be sold for more than the cost of its coal equivalent, only a part of it, even where the ovens are connected with steel works, may be used as fuel, consequently even if all coke were by-product, it is doubtful if over one-half the tar would be commercially available for use in the steel industry.

Many of the merchant blast furnaces are of small capacity and are located in outlying districts where there is no use for the waste heat, which consequently must be lost.

Considering the above, it is highly improbable that, even given the best conditions of equipment, there would be sufficient waste heat for operating the entire industry, but it is possible for some well balanced plants to very closely approach the ideal condition, i.e. where the only coal required for the entire works would be for the coke ovens.

Coke ovens and blast furnaces operate continuously, whereas steel works and rolling mills are normally idle over the week-end, consequently about one-seventh of the waste heat from the principal sources is given off when there is no use for it by the largest consumers,

which also means that even in the ideal plant, there would probably be a shortage of waste heat during six days of the week. This condition can be met by tying the electric power system of the plant to the lines of a local public service company and interchanging power with them. The steel company would take a comparatively small average amount of power during the week, and over week ends the public service company could shut down part of its capacity, thus in the final analysis, saving the waste heat from the coke ovens and blast furnaces during that period. There are at least three places where this arrangement is in force and two others where negotiations towards this end are now in progress.

An inspection of almost any of the present plants will disclose opportunities of material saving in fuel with little or no capital expenditure, but the older plants can be made efficient in this respect only by the expenditure of considerable amounts of money. This fact has caused many companies to act slowly, but the realization of the present waste of natural resources and the savings in cost shown by modern equipment have apparently awakened the industry to the advisability of thoroughly revamping existing wasteful methods, and if this interest results in only maintaining the rate of progress shown during the past few years, the waste will be reduced at least one-half within the next decade.

Deductions.

From the data, estimates and general history of the are as outlined above, the following are deducted as the present, and probable future, tendency of power generation and application in the iron and steel industry:

1. Electrification of all power driven apparatus except blast furnace blowers.
2. Substitution of turbo-blowers, or possibly gas engines, for reciprocating steam blowing engines.
3. Purchase of power requirements by plants which have no waste heat available.
4. Complete economical utilization of waste heat by means of turbo-generators for electric power generation, except where this heat can be used to better advantage for "process" or has a market value greater than its coal equivalent.
5. Interchange of electric power between plants generating power from waste heat and public service companies.

Mineral Service Bureau to Develop Industry

Establishment of an Industrial Minerals Service Bureau, under supervision of its Geological Department, is announced by the Southern Pacific Company. Comprehensive data concerning deposits of minerals suitable for commercial purposes is being gathered for use of manufacturers in all parts of the United States and even in foreign countries. Thousands of questionnaires, upon which are listed commercial minerals needed for production purposes, have been sent to manufacturers. Replies from these now are being received by the bureau.

The service bureau of the Geological Department comprises a part of the general plan of the Southern Pacific to materially aid in developing western states served by it. The bureau acts as a clearing house through which the needs both of the producer and the manufacturer are met.

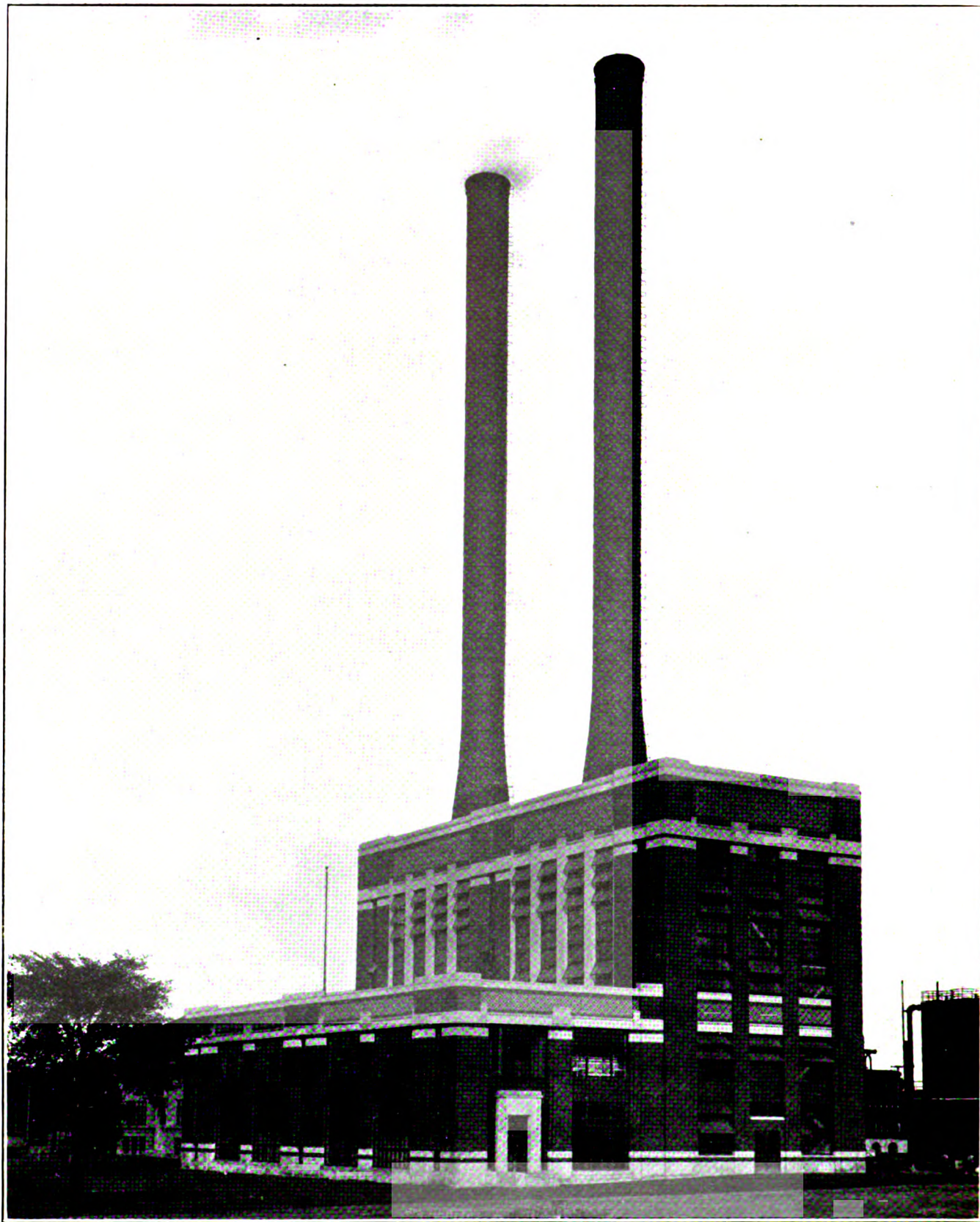


FIG. 1.—The new Ford Canadian Power Plant located at Walkerville, Ontario.

A Super-Power Plant

First Few Months' Operation Indicates That Exceptional Performances May Be Expected

By F. J. CROLIUS

MODERN power houses are usually very difficult to visualize in their entirety, because of their unusual size and from the very nature of the operation, which requires distinct sub-division of essential parts or elements.

Take, for instance, the power plant of the Ford River Rouge works, which is a marvel of detail. The River Rouge layout, operated on a variety of fuels, but mainly blast furnace gas and powdered coal, is so large and covers such an area that an adequate grasp of its detailed construction and assembly is a study in itself.

Tracing back the fuel supply either to the two blast furnaces, or to the coal preparation plant adjacent, disturbs the total perspective; a trip through the boiler room where pulverized coal through a multitude of burners, and blast furnace gas from huge mains are together introduced into 80-foot combustion chambers, gives not the slightest idea of this relation to the generating room; the separate pipe floor, with its complexity of water, steam, air and conduit pipes

merely arouses admiration for the engineering genius with foresight enough to concentrate all major pipe and valve inspections and repairs into a single accessible location.

But the Ford Canadian power plant is of just the size to present a complete picture and, typical of all Ford operations, the picture is one of immaculate cleanliness, fine attention to detail, with just enough of the severe artistic to be colorful while extremely practical and economical.

The Canadian Ford plant contains every important element which goes to complete the modern power factory (plus a number of expensive novelties never before introduced), and yet figures will show that it is probably the lowest cost modern unit which has yet been built. It is a monument to the methods and engineering ability of the Ford organization and to John Anderson, chief engineer of this Canadian division, whose ideas here found expression.

Fig. 1 is a remarkable picture of the power house as it appears as you approach from the river. Unusual

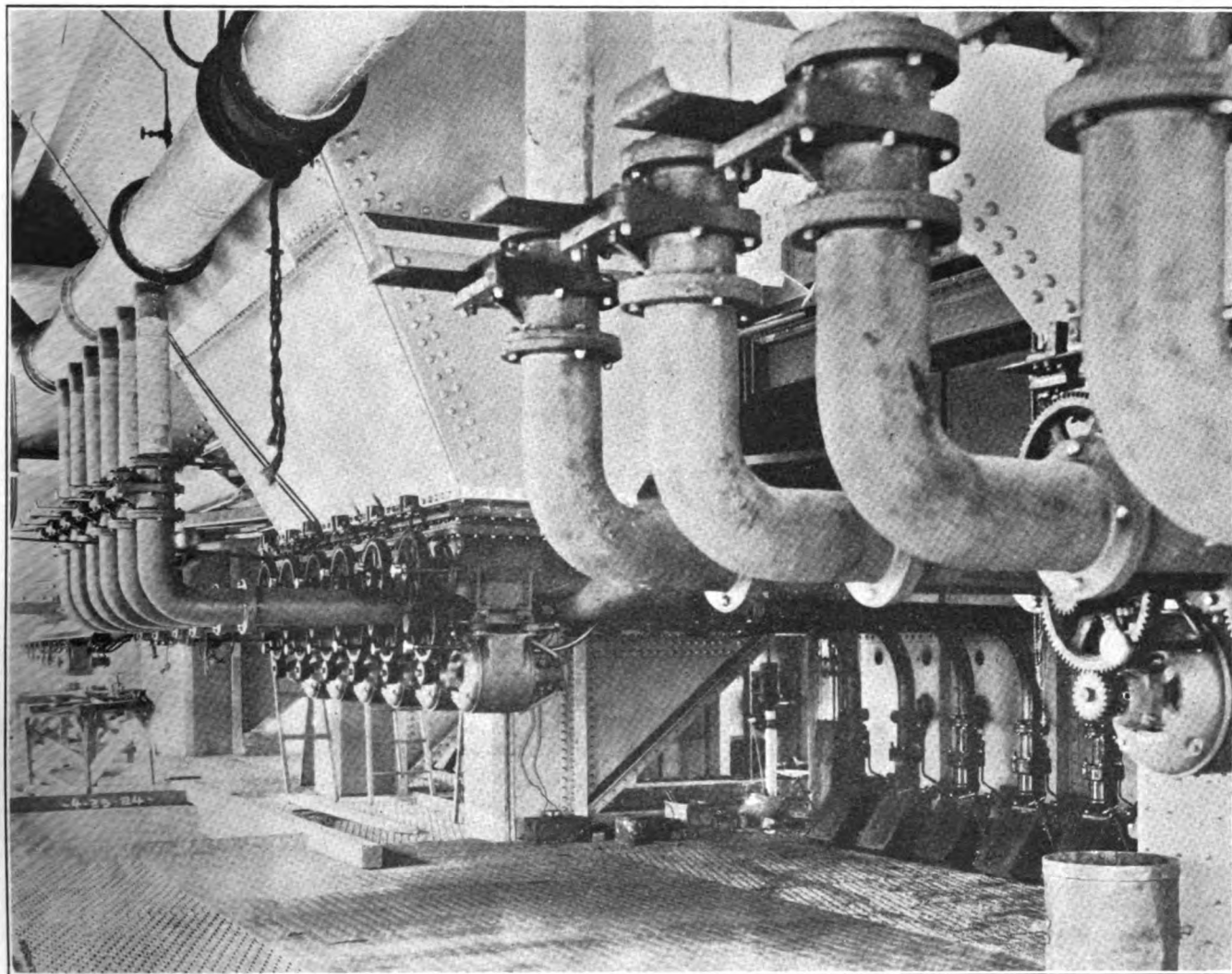


FIG. 2.—A remarkable view of the pulverized coal feeders, indicating the accuracy of control.

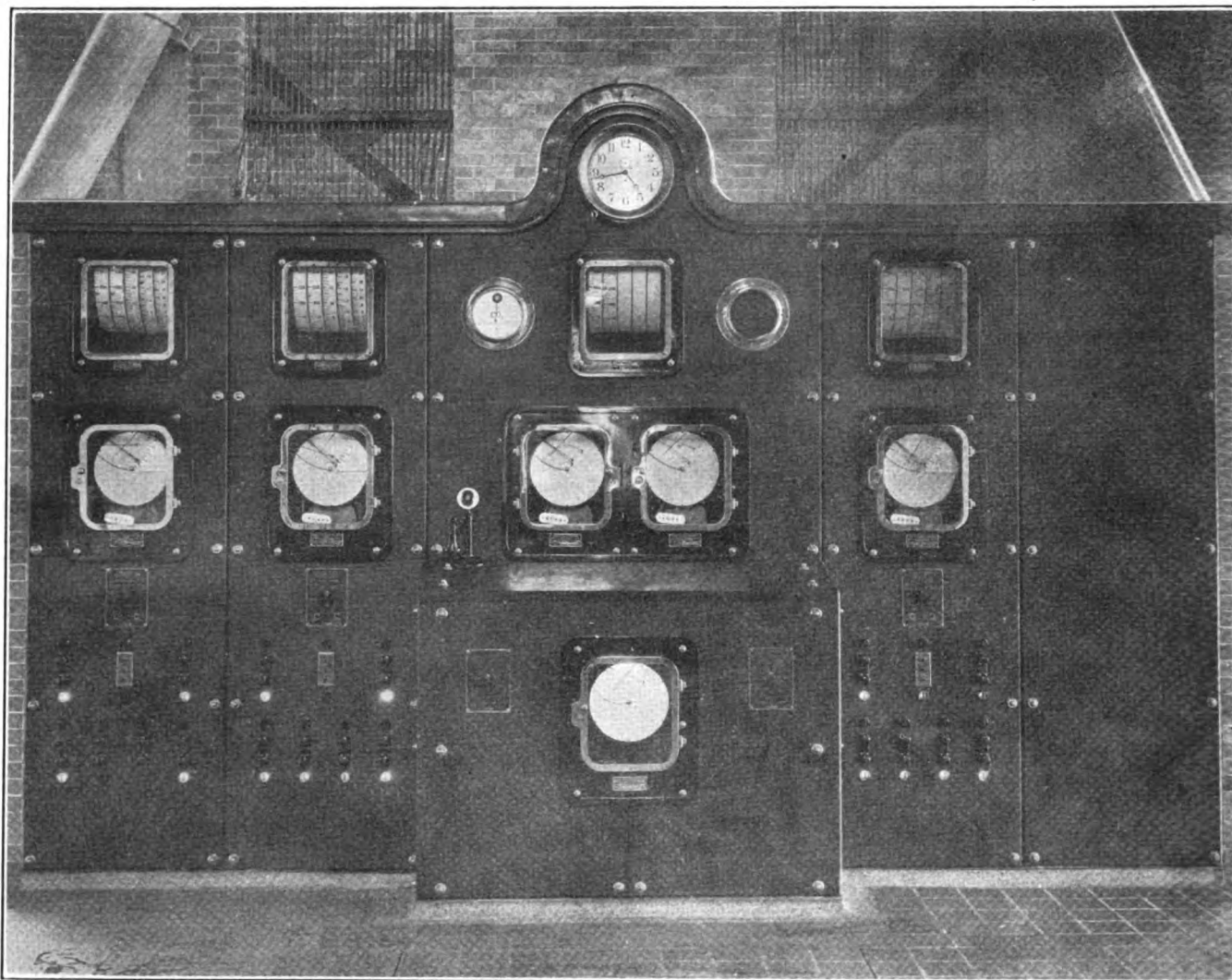


FIG. 3.—Every detail of boiler operation is indicated or recorded with Bailey metering equipment, similar to that shown above. This panel shows a Bailey multi-pointer gage type P5FF to indicate boiler drum pressure, superheated steam pressure, primary air pressure, furnace draft and uptake draft; also a Bailey boiler meter type D26F class 45 to record the rate of steam flow, the air flow used for combustion, the superheated steam temperature, and the flue temperature for each of three 1361 hp. McAleenan boilers equipped to burn pulverized coal. The double flush front recorder shown in the middle of the above panel board consists of a Bailey fluid meter, to record and integrate the total boiler feed water as well as to record the pressure and temperature of this water. The right-hand portion of the double flush front casing contains a feed water meter which is connected to orifices in each of the individual boiler feed lines so that by the manipulation of the proper valves this meter can be used to measure the amount of water fed to any individual boiler. The multi-pointer gage mounted in the center of the board indicates feed water pressure and steam pressure in the main header. The most important results are recorded on the 12-inch uniformly graduated meter charts and the secondary factors are indicated on the illuminated scales immediately above the records, so that the boiler operator has everything right before him to obtain the desired capacity and best efficiency at all times.

to such buildings, an expanse of smooth lawns surrounds the structure; no railroad tracks, coal docks or ash cars obstruct the picture—as an integral part of this plant they simply do not exist.

The view from the control board level of the building shows the broad Detroit river, with the City of Detroit immediately across, and a constant procession of lake steamers laden with ore and grain and coal making their voyages to and from the ore docks and elevators of the upper lakes to the furnaces and ore unloading docks in the lower lakes.

On this immediate water-front is observed the huge coal storage containing some 100,000 tons, with coal unloading and distributing bridge facilities designed to supply not only this power house, but also the low-temperature carbonization plant which adjoins, and which ultimately will deliver its soft structure coke into the power house as fuel, while the gases, benzol and other by-product recoveries find their way

to the tank storages now waiting. This is the ideal upon which the plant was designed, and the success of the total plan will bear heavily upon future power plant tendencies.

No raw coal enters the power house. Through a long underground tunnel this supply from the storage bridge is carried on Beaumont horizontal conveyors through to the coal preparation plant which forms an integral part of the carbonization plant, where local storage bins receive it.

There are no coal driers. Even though an occasional supply of fairly high moisture coal is encountered, to date no inconvenience has resulted.

Coal is pulverized by three standard 6-ton Raymond mills, and the pulverized product is distributed to the individual bin structures located above the boilers themselves by the conventional screw conveyor system (similar in design and construction to the same equipment in service at River Rouge).

Fig. 2 was taken at the level of the feeders, and shows the piping bends leading from the pulverized bins through the feeders and to the top of the furnaces. All fittings are nicked and everything is substantial and dust-tight.

There are 18 single feeders, six to each boiler, each leading to its individual burner. These feeders are subject to and can be independently controlled from the burner floor by the operator stationed on this level. This equipment is the well known Lopulco system of feeder and burner design made familiar to Ford operators after several years' experience with the same device at River Rouge.

The furnaces are Lopulco hollow wall air-cooled design, and are protected in their operation with Lopulco water screens. Fig. 3, which shows a cross-section through the boiler and furnace setting, gives an excellent idea of the relative proportioning of the furnace volume to the boiler itself; this figure also shows the positioning of the Elesco superheaters within the initial bank of tubes.

The present installation of boilers consists of three 1,350-hp. (rated) McAleenan water tube boilers. This design of steam generating units lends itself admirably to a furnace designed especially for burning pul-

verized fuel at high ratings. Preliminary tests and observations made during the short period of operation give every indication that the builders' expectations will be surpassed. After nearly nine months of operation, that is since April, 1924, there has been absolutely no maintenance expense chargeable to furnace walls.

Adequate control of combustion forms an important and interesting feature of this power house. Volume air for combustion is admitted to the hollow furnace walls through a system of Bailey damper doors, positioned vertically in the side-walls and extending from top to bottom of the furnaces; these instantly respond to differences in furnace pressure. Balanced pressure is maintained and controlled automatically from the boiler floor level by means of a complete Bailey control board which visualizes the operating conditions so minutely that a single operator by mere push-button change can maintain a given desired result.

The superheater, furnished by the Superheater Company, is that which is becoming properly known as the outside header construction with the units extending through the roof of the boiler and located between the tubes in the first bank of the boiler.

In semi-vertical boilers, the steam generating tubes are placed in straight rows, and not staggered

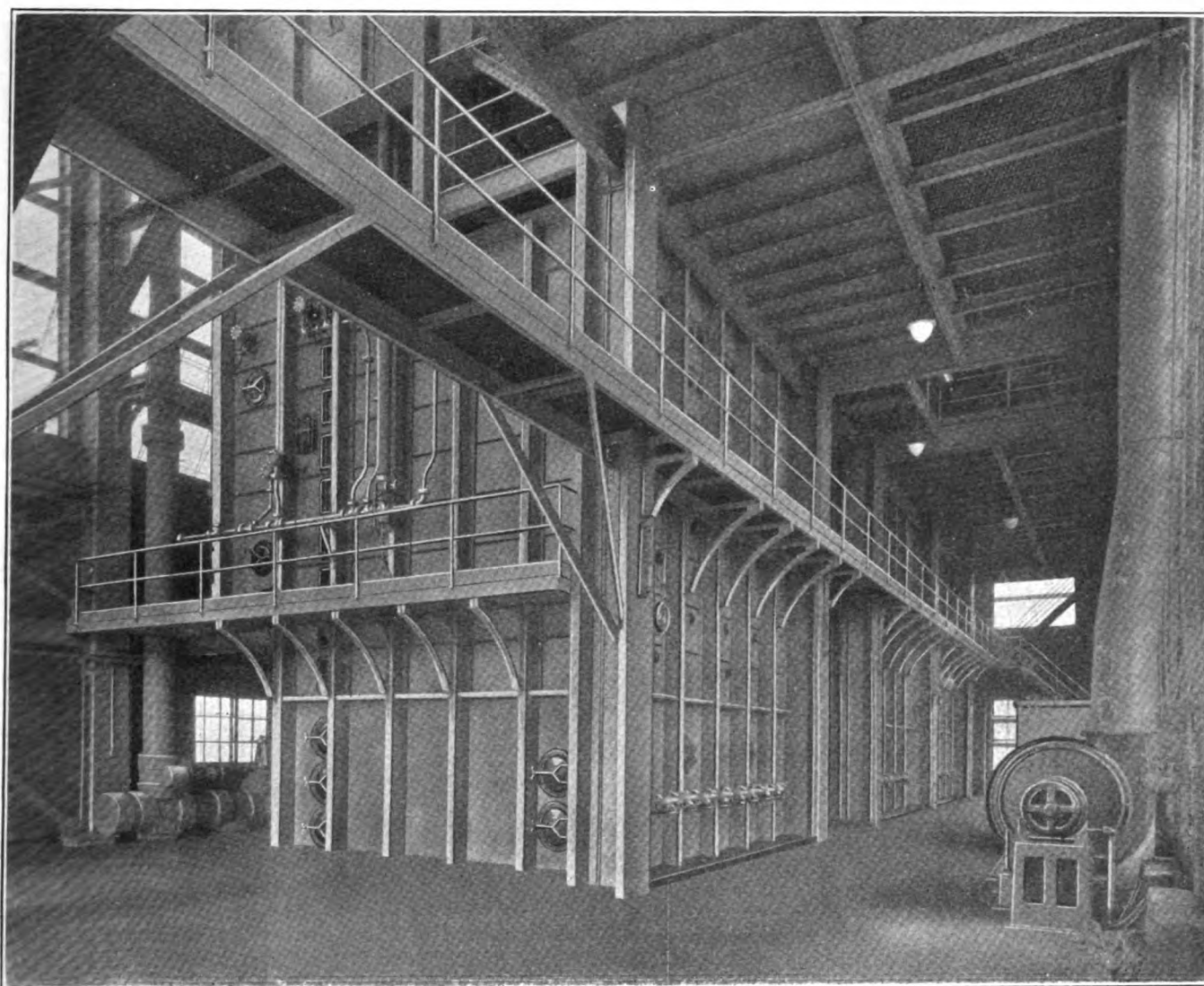


FIG. 4.—As you look through the boiler room from this level, the immediate impression is one of wonderment that steam can be generated under such ideal conditions. There is no noise, or dirt or dripping water; the most perfect routine is evident.

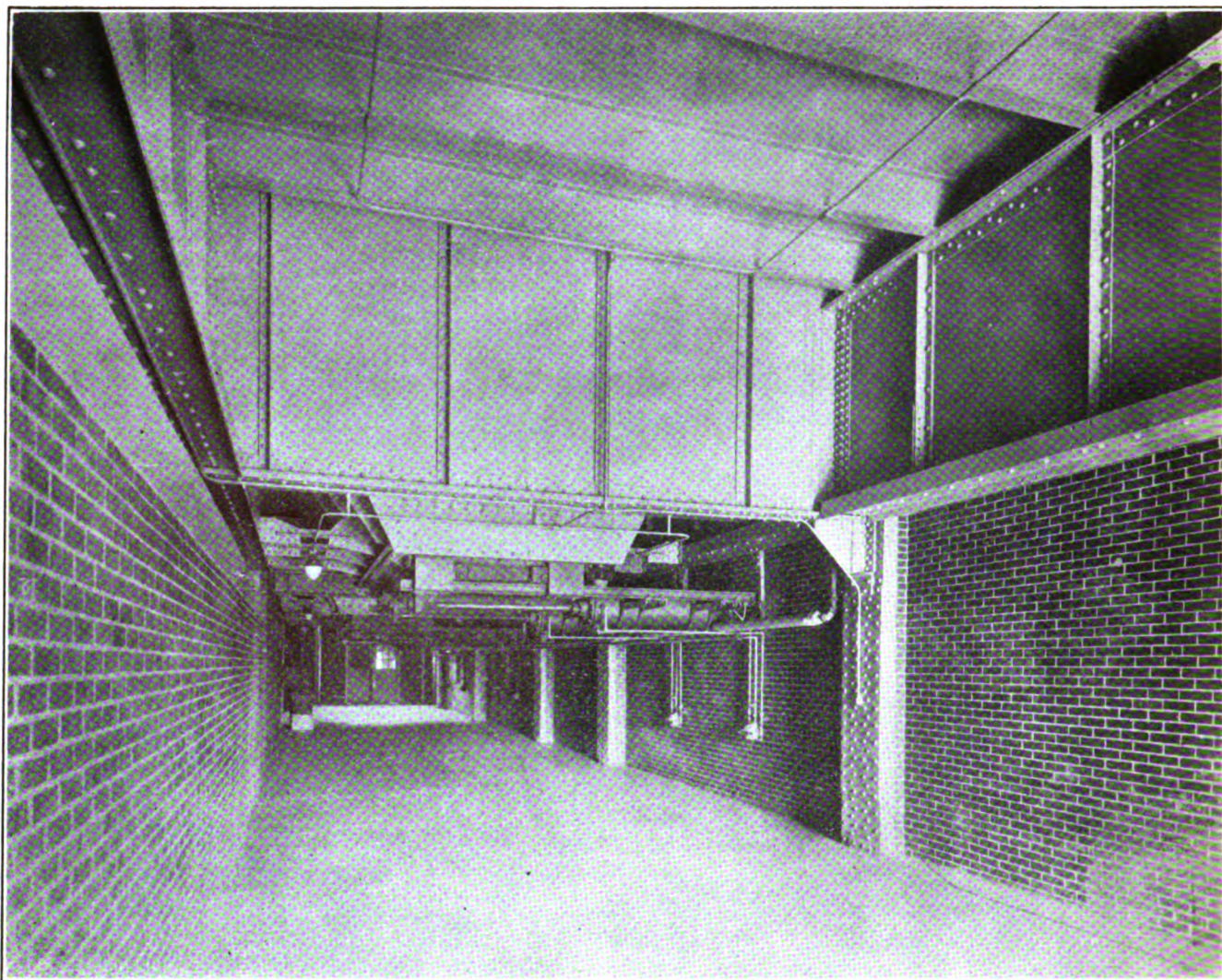


FIG. 5.—This view of the ash-cellar is startling, when compared with the usual procedure. The bottoms of the ash hoppers are perfectly sealed and the room is as clean and free from gases as the turbine room.

as is the case with horizontal water tube boilers. The rows are spaced unequally, every other one being large enough to facilitate the removal or renewal of a tube. In the Walkerville plant, where the superheater units are located between the tubes in the first pass, more tubes are placed in the larger space than in the smaller one to distribute the gases equally over the entire width of the boiler. The units are also located so that they break up the flow of the gases with the same effect as the staggered arrangement, i. e., that the boiler tubes are swept by the gases. The first pass is, therefore, more efficient, with lower final gas temperature and better overall efficiency of the boiler as the result. This design was originally applied to the River Rouge boiler and has since been installed in innumerable Ford plants, as well as many other industrial and public utility stations.

The regulation of superheat, coupled with low pressure drop and minimum draft loss are the principal features from the standpoint of design. The fluctuation of superheat is within 15 to 20 deg. from 100 to 350 per cent of rating, a feature which the turbine manufacturers particularly desire. The amount of pressure drop is lower than is customary for high superheat and the draft loss, caused by the superheater, is so slight that it can be measured only with difficulty, except at the higher ratings.

Operating men favor this style of construction because it eliminates congestion inside the boiler setting and permits free access for inspection or repair of baffles without the interference of superheater header or elements. The joints located on the outside of the setting are accessible at all times for inspection. In case of necessity to replace boiler tubes or make other changes, the superheater elements can be withdrawn easily to facilitate such work.

It was because of the demonstration of the ability of this design to give uniformity in temperature and particular ease in operation that these superheaters were purchased for this plant.

Unique Heating System.

In designing the new plant of the Ford Motor Company at Ford City, Ont., efficiency was the watchword of the company engineers. One of their achievements in this line is found in the method employed for heating the plant during the cold weather. A combination of power plant and heating system was decided upon and the various builders of steam turbines were called upon to offer suitable turbine equipment.

The Allis-Chalmers Manufacturing Company was able to offer a combination of one special 5,000-kw. variable vacuum steam turbine and one 10,000-kw.

condensing steam turbine which worked out to the satisfaction of the Ford engineers and a contract was placed with the Allis-Chalmers Manufacturing Company for this equipment. This combination has special features which are briefly outlined below:

Both turbines operate with steam at 200 lb. gage pressure superheated to 200 deg. F. The 10,000-kw. unit is a condensing machine operating under a $28\frac{1}{2}$ in. vacuum. The 5,000-kw. unit is designed to operate condensing with a vacuum varying from $28\frac{1}{2}$ in. to 4 in. Normally when heating is not required the circulating water for the condenser in connection with this unit is taken from the river and after passing through the condenser is returned to the river and the turbine operates under the highest vacuum ($28\frac{1}{2}$ in.) During the cold weather when the demand for heat is greatest, all of the cooling water passing through this condenser will be circulated in the heating system. As the need for heat becomes

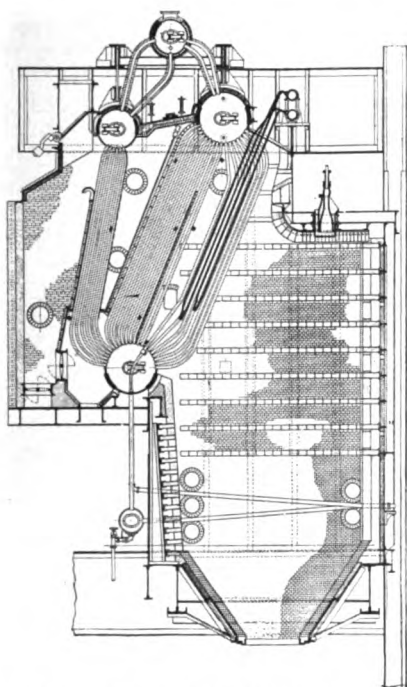


FIG. 6.—Showing arrangement of Elesco superheater in the first bank of boiler tubes.

greater, less river condensing water is circulated and the temperature of circulating water is thus caused to rise and the vacuum is lowered to raise the temperature of the circulating water sufficiently for heating requirements.

If still more heat is required, steam is then extracted from an intermediate stage of the 10,000-kw. unit, which is a straight condensing turbine except for this feature. The steam taken from this unit is used in what is known as a stage heater to further increase the temperature of the water circulating through the heating system and is extracted in amounts sufficient to bring the heating system to the required temperature.

This method of heating the Ford plant is highly efficient and is novel in that the steam used for heating purposes is made to do the maximum of useful work before it reaches the temperature required for heating purposes. As the demand for heat changes, the vacuum and the exhaust steam temperature varies

correspondingly so that the units which are inherently highly efficient are operating at all times as economically as is consistent with prevailing conditions and with the heat requirements.

Noticeable about this unique steam plant is the appearance of the steam lines. All are covered to meet the conditions of high temperature steam and local extreme variations. A picture of the water-screens with their well covered headers and pipe inlets is typical of the entire system. The method of varicolored painting which distinguishes the different pipe lines is in harmony with all Ford practice.

More Protection for Indian Steel Industry

(Continued from page 38)

A subsidiary concern of the Tata Company, the Indian Steel Wire Products, Ltd., made application to the Tariff Board to have the present 10 per cent duties on wire and wire nails increased, but the recommendation made is that barbed and fencing wire shall be subject only to the existing duty, whilst on other kinds a duty equal to 25 per cent shall be levied. This will take the shape of a specific duty of Rs. 60 per ton, to which increased charge wire nails will also be subject.

Certain agricultural implements and the parts thereof will have the present duty of 15 per cent increased to 25 per cent to please the few manufacturers.

It will be seen that this new tariff, if passed into law, is for the present, at any rate, going to be merely of great value to the Tata Company. The latter has urged that unless increased tariff protection is afforded the existence of steel manufacture in India will be placed in danger and that without such protection there is certainly no prospect of further development for a long while. This may be so, but the tariff as proposed places the Tata Company in a privileged position. When all is said it is practically the Indian steel industry and not likely to be seriously challenged by any competitor for many years. It is therefore to be hoped that the company will use the power given it moderately and not squeeze the consumer unduly, because he appears to be in the unfortunate position of having no effective means of defence.

Data on Structural Material

Values of the strength of pure metals and their alloys, and of wood, are given in the revised edition of the Bureau of Standards circular on the physical properties of materials. The data include the strength in tension, compression, and in shear, the resistance to fatigue, and many other properties which an engineer must know in order to design a structure that will safely carry its intended load. The effect of high temperatures on the strengths of different metals is shown by tables and by graphs, and the physical properties such as specific gravity, melting point, and coefficient of expansion are given.

The information given is compiled from various sources, including tests made at the Bureau of Standards.

These data are given in Circular 101 of the Bureau of Standards, Department of Commerce, entitled, "Physical Properties of Materials." Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 40 cents.

TRADE PUBLICATIONS AND NOTES

Riley Stoker Corporation

Constant enlargement of the activities of the Sanford Riley Stoker Company and its subsidiaries has made it advisable to change its name to the Riley Stoker Corporation. This becomes effective January 1, 1925. This change is wholly a matter of convenience in transacting the rapidly growing business of the company, there being no change whatever in management or policy.

It is interesting to recall that the Sanford Riley Stoker Company was founded in 1913 to make the Riley underfeed stoker. From the very first the growth of the company has been rapid. To be able to offer the trade a type of stoker best suited to their individual conditions, various stokers have been added to the line until now the Riley Stoker Corporation can offer a type that meets any condition.

The Riley Stoker Corporation is a consolidation of, and successor to, the following companies: Sanford Riley Stoker Company, makers of Riley underfeed stokers; Murphy Iron Works, Detroit, Mich., makers of Murphy furnaces since 1878; Underfeed Stoker Company of America, makers of Jones stokers since 1890; United Machine & Manufacturing Company, Canton, Ohio, makers of Harrington stokers.

H. A. Brassert & Company

H. A. Brassert, president of H. A. Brassert, Inc., consulting engineers, has sold his interest in Freyn, Brassert & Company, Engineers, to that company. He has resigned as chairman of their board, but will continue to act as consultant for them. The name of Freyn, Brassert & Company will be changed to Freyn Engineering Company, effective January 2, 1925. Mr. Brassert also recently sold his interest in Miami Metals Company. By relinquishing his financial interests in these companies, Mr. Brassert and his associates, Mr. E. L. Ives and Mr. A. J. Boynton, can more advantageously devote themselves to consulting, reporting and the operation and management of properties. The name of H. A. Brassert, Inc., has been changed to H. A. Brassert & Company.

Stoker Manufacturers' Association Booklet

"The Condensed Catalog of Mechanical Stokers," which the Stoker Manufacturers' Association has recently issued, is most interesting to all power engineers. This book is very unique in that it is a complete catalog of the various competitive manufacturers of mechanical stokers. It is a part of the educational advertising campaign being conducted by the Stoker Manufacturers' Association.

The book is a very good example of the possibilities in co-operative advertising for competitive companies. As far as we know, it is the only co-operative catalog that has ever been published by competitive manufacturers of mechanical equipment.

Automatic High Voltage Compensator

An automatic high voltage compensator has recently been placed on the market by the Electric Controller & Manufacturing Company of Cleveland, Ohio. This compensator is built for voltages of 2500 and below. It is push button operated and entirely automatic. With the exception of the overload panel, which is mounted on the top of the tank, the compensator is entirely submerged in oil and the tank is so designed that the compensator is dust-proof, weather-proof, vapor-proof and fire-proof.

A push button is operated by an independent low voltage circuit which is taken from an independent transformer so that there is no danger of the operator ever coming into contact with the high voltage circuit. Having the starting transformers and the operating mechanism entirely submerged in oil and automatically operated removes all possibility of explosions or high voltage flashes.

This automatic compensator is so designed that continuous torque is applied to the motor from the time the push button is pressed until the motor has been brought up to speed. Operating the start switch causes the motor to be started under reduced voltage obtained from the transformers in the compensator and after the motor has reached the proper and safe speed it is automatically thrown across the line by the compensator.

It is believed that a great many more high voltage motors will be used now that a safe high voltage starting compensator has been placed on the market.

Tate-Jones Issues New Bulletins

Two new bulletins are being distributed by Tate-Jones & Co., Inc. Bulletin No. 175 covers electric heat treating furnaces, both of standard design and also gives illustrations of various furnaces built for special work in the last few pages of the bulletin. Rotating hearth electric furnaces are also covered, together with photographs of actual installations.

Bulletin No. 163-B covers underfired heat treating furnaces which can be utilized with either gas or oil and the pertinent facts regarding these furnaces are carborundum piers; delicately balanced doors, so that a man can raise and lower a door with one finger; positive cam type door checks for rigidly sealing the door in position; two courses of insulation on the sides of these furnaces; rigid steel binding and smooth level surface, permitting easy unloading and placing in position in the shop.

Tate-Jones & Company, Pittsburgh, Pa., manufacturers of gas and oil-fired and electric furnaces, gas and oil burners and accessories, has made an arrangement whereby all sales will be handled by the General Furnace Company, 1015 Chestnut Street, Philadelphia, Pa. Tate-Jones & Company will continue the manufacture of equipment.

The General Furnace Company will take over the Tate-Jones sales force and sales offices. This arrangement went into effect January 1, 1925.

*Views of a Variety of Manufacturer's
Power Show Exhibits*



NEWS OF THE PLANTS

The Ford Motor Company, Highland Park, Detroit, Mich., is perfecting plans for the construction of four new open hearth furnaces at its steel works, comprising an initial allotment of about 34 such furnaces, in all, the remainder to be built at different intervals. The expansion will also include the building of four soaking pits, especially designed for the use of coke oven gas. Other improvements and extensions are projected, including the installation of a number of electric furnaces and accessory equipment.

The Penn Seaboard Steel Corporation, Franklin Bank Building, Philadelphia, Pa., has authorized an increase in its capital stock from 1,500,000 shares of stock, no par value, to 3,000,000 shares of stock, no par, the proceeds to be used in part for proposed extensions and improvements in its plant at New Castle, Del., to include the installation of two new open hearth furnaces; one-story steel strip mill, and several auxiliary buildings, estimated to cost close to \$900,000, with equipment. It is expected to proceed with the work at an early date. J. B. Warren is president.

The Dominion Sheet Metal Corporation, Ltd., Hamilton, Ont., has plans nearing completion for the erection of a new plant at Montreal, Que., for the manufacture of galvanized steel sheets. It is expected to break ground at an early date and have the works ready for service in the near future. The project is reported to involve in excess of \$500,000, with machinery. The company is reported to be considering the installation of additional equipment at its Hamilton mill for extensive increase in production.

The Central Steel Company, Massillon, Ohio, is arranging for the early construction of its proposed new 600-ton blast furnace and will consummate material purchases and details within a short time. The project will include a new ore-handling bridge, provided with 10-ton bucket, as well as a new central power plant for general works service. The company has tentative plans under advisement for the construction of a by-products plant, but will likely defer the work for a number of months; this latter project will be carried out in connection with other expansion.

The Youngstown Sheet & Tube Company, East Chicago, Ind., with headquarters at Youngstown, Ohio, is said to have authorized plans for the construction of an addition to its steel fabricating plant, for which details will be determined at an early date. The reported cost is placed at close to \$250,000, with equipment.

The Inland Steel Company, Chicago, Ill., has plans under way for the construction of two new blast furnaces at its Indiana Harbor, Ind., plant, to be in addition to the three stacks now at this works. Following a compilation of the estimates of cost, it will be decided as to how soon the project will be placed in progress. Work is now under way on relining and other improvements at one of the existing furnaces, and it is said that the unit will be blown in at the earliest possible date.

The Acme Steel Goods Company, Chicago, Ill., has work in progress on a new continuous hot band mill at its plant at Riverdale, Ill., and purposes to have the unit ready for the machinery installation at an early date. It has been designed for a capacity of about 10,000 tons per month of rolled bands, from 6 to 12 in. wide. The new unit will double approximately the present capacity of the hot band rolling department at the mills.

The Bethlehem Steel Company, Bethlehem, Pa., is proceeding with the construction and improvement program adopted for its several mills a number of months ago, involving in all close to \$60,000,000, including work now completed, in process and in prospect. Extensive additions and betterments are being made in the Cambria works, Johnstown, Pa., to include the complete remodeling and modernizing of the bar department, with the installation of considerable additional machinery. A new blooming mill, billet and sheet bar mill have been completed at this plant, and are now in service. At the North Lebanon, Pa., mills, the company is said to be perfecting plans for the construction of a continuous mill, estimated to cost about \$350,000, with equipment; the concentrating plant at this works has recently been placed in operation on a full time production basis. Construction is being pushed on the new structural steel mills at the Lackawanna plant at Buffalo, N. Y., and it is expected to complete the buildings and installation of machinery during 1925. A total of 12 tin plate mills are being arranged at the Sparrows Point plant, Baltimore, Md., and the new plant is expected to be finished within a short time, increasing the output about 50 per cent. The company recently placed its rail mill in service at this plant, following complete rebuilding and electrification, with the modernizing of equipment.

The Trumbull Steel Company, Warren, Ohio, has work in progress on a number of additions and improvements in its plant to involve an expenditure of close to \$500,000, and will push the program to completion. A large part of the fund will be used for expansion in the steel galvanizing department, which will be considerably increased; different portions of the plant are being electrified and new electric power equipment installed. The company is considering tentative plans for the construction of a number of new open hearth furnaces, of which the plant now has seven; this quota, it is understood, will be expanded eventually to 12 furnaces. Jonathan Warner is president.

The Thomas Sheet Steel Company, Niles, Ohio, has completed the reconstruction of six of its group of 12 sheet mills, and the units have been placed in service. This practically completes a program for the modernizing of the entire sheet mill department, and it is expected to develop capacity production at an early date. The company has been making other betterments at the plant for greater economy in manufacture.

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The Blast Furnace *(and)* Steel Plant

Member of the Audit
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**WHEELING
QUALITY**

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**A Happy and Prosperous
New Year
is our Wish to You**

**WHEELING MOLD
AND FOUNDRY CO.
WHEELING, W. VA.**